

Official Notice.

ALCOHOL FOR INDUSTRIAL PURPOSES.

In a letter dated March 4, 1914, addressed to Mr. C. T. Needham, M.P. (Hon. Secretary of the Association of Chambers of Commerce of the U.K.), the Commissioners of Customs and Excise have supplied the following information on the subject of alcohol for industrial purposes:—

ALCOHOL is allowed to be used duty-free for industrial purposes on the following conditions:—

1. *Methylated spirit*.—This is spirit which has been denatured by licensed or authorised makers under the supervision of the Revenue officials.

It is of two kinds:—

(a) "Industrial methylated spirit" which is a mixture of strong spirits with 1/19th of its bulk of wood naphtha or other substance or combination of substances approved for the purpose by the Commissioners. The mixture can only be supplied by the makers to persons who have the authority of the Commissioners to receive it for use for specified purposes in any art or manufacture carried on by them.

Except when the quantity to be received is very small the user is required to enter into bond for the proper use of the spirit, and under any circumstances the premises are visited from time to time by the revenue officers.

(b) "Mineralised methylated spirit" which is a similar mixture to (a) except that the proportion wood naphtha or other approved denaturant is 1/9th of the bulk of the ordinary spirit, and that in addition it contains not less than 3/8th of one per cent. by volume of approved mineral naphtha or petroleum oil. This mixture is used in those arts and manufactures for which it is suitable and in connection with which there may be some objection to sanction the use of industrial methylated spirit. With the authority of the Commissioners it may be received in the quantities required in such cases. The risk of using it for potable purposes is not so serious as in the case of the less impure mixture (industrial methylated spirit), and consequently the manufacturer who employs it on the large scale is not in ordinary circumstances required to enter into bond, but notwithstanding this, his premises are subject to a certain amount of revenue supervision. This mixture may be sold by licensed retailers to any person in quantities not exceeding 4 gallons at one time, and in fact the great bulk of this description of the spirit is disposed of in this way. The spirit thus sold is used for heating purposes and for making french polish in comparatively small quantities.

2. *Duty free alcohol other than methylated spirit*.—Under Section 8 of the Finance Act 1902, the Commissioners may, subject to such regulations as they may make, authorise the receipt of pure spirit for use duty free, in any art or manufacture in which the use of spirits is required, and where it is proved to their satisfaction that methylated spirit is unsuitable or detrimental. The conditions which have been imposed are, as far as possible, adapted to the circumstances of each case; but the manufacturer must give bond that he will use the spirit on his premises for the authorised purpose; an account of the spirit on receipt at the manufactory must be taken by a revenue officer, and before use it must be mixed in his presence with such denaturants as may have been approved by the Commissioners

in connection with the particular manufactory. The use of the denatured spirit is also subject to supervision of a more or less stringent character according to the extent to which it has been rendered unfit for consumption, the facilities which may exist for purifying or redistilling it, and other circumstances.

Petrol tax.—The tax on petrol is levied only on spirit used to supply motive power for motor cars. The amount of the tax is:—

For private motor cars	3d. per gallon.
For motor cars standing or plying for hire (omnibuses, taxicabs, etc.), trade motor vans, and motor cars used by medical men in their professional duties	1½d. per gallon.

As a matter of convenience in collecting the revenue from spirit used in motor cars, the full duty of 3d. is, as a rule, paid on the spirit on delivery from the manufactory, refinery, or warehouse, but if it is ultimately used for a purpose for which the half duty spirit is applicable, half the duty paid is allowed as a rebate to the actual user. In the case, however, of persons who use over 500 gallons per annum for generating power for driving taxicabs, omnibuses, and trade vans, arrangements are made to allow them to receive the spirit from bond on payment of half the full duty.

No tax is levied on any spirit used for the generation of power, or for motor purposes, other than that on petrol used for motor cars, but it may be observed that duty-free alcohol, except in the form of mineralised methylated spirit, is not allowed to be used for those purposes.

Liverpool Section.

Meeting held at the University, on Wednesday, November 25th. 1914.

PROF. F. C. C. BALY IN THE CHAIR.

THE FUTURE POSITION AND PROSPECTS OF THE BRITISH CHEMICAL TRADE, AND THE QUESTION OF CONCERTED ACTION BY MANUFACTURERS.

The CHAIRMAN said that it was obvious that a situation which had been growing up for the past 40 years could not be reorganised to meet entirely new conditions at a moment's notice. One of the essential reasons for the paramount position of Germany was the intelligent co-operation between University and manufacturer, a co-operation which was conspicuous by its absence in this country. The success of the great German chemical manufacturing firms was very largely, if not entirely, due to a progressive policy, rendered possible by the possession of a research laboratory, fully equipped and manned by a very efficient and large staff of University-trained chemists. In Great Britain each University turned out every year a number of fully trained chemists, the average product of the English University being quite equal to the average product of the German;

the best product of the English University was superior to the best product of the German University. The opening for research chemists, fully trained in the most modern developments of chemistry—an opening in which they could make good use of their knowledge—had been practically non-existent. Even supposing that the training of these men were modified on the lines which had been suggested on many occasions, what would happen? The man would be expected to carry out routine analyses or to watch a process, which in all probability was as stereotyped as the analytical methods themselves. That was not the ideal for which they in the Universities trained their men. Their best men, after a year or two of research, were worthy of higher things. There was in this country the raw material in plenty, and we possessed in full the men and material for entering the new field of progressive manufacture and for its successful tillage.

The great difficulty to his mind lay in the individuality of manufacturers. They had to learn that the establishment of a fully manned and equipped research laboratory was an essential preliminary to the erection of new works. The duty of the research staff, at first, would be to devise methods for the production of such compounds as were urgently needed. After that, they could carry out work with the view to discovering new dyestuffs, for example, for a second factor contributing to Germany's success had been the continuous introduction of new products. One point he urged, namely, directly a particular process had been proved to be successful and economically sound, it passed out of the experimental stage and needed no further control by the research staff. That research staff should be well paid and should not be expected to be responsible for any process after it had become stereotyped.

One essential factor was the financial factor. The demand for drugs and dyestuffs was urgent, and the manufacturer who undertook that work should not be expected to invest large sums of money in the establishment of a research laboratory and the erection of plant, if at the end of the war the Germans were able to undersell him at every turn. Yet the drugs and dyestuffs must be produced. Surely if the nation demanded those products, it must guard those manufacturers against financial loss. He suggested that any substances produced under the new scheme, should be protected by a tariff to be terminable after a limited number of years. The tariff should continue in force for sufficient time to enable the manufacturers to arrive at the best economic conditions of work, and, in short, firmly to establish themselves.

Mr. J. W. PATON stated that he was a manufacturer of metal polishes, boot polishes, and cardboard boxes of all descriptions. In addition his firm were printers and enamellers of tin plate, and manufacturers of all kinds of tin boxes and canisters. They also made certain lines in toys which were protected by patents and copyright designs. At the present time they were not dependant on the Continent for anything they used. They had their own silica mines in America. Where they held patents and special designs they had been able to maintain their trade, but for lines which were not in any way protected they had found it impossible to compete with Germany, the latter country having flooded the market with goods which appeared to be sold practically at cost price. The exceptional facilities which German manufacturers had always received from their Government and from their Banks had made it impossible for English manufacturers to stand against them. Since the war broke out, many mechanical toys and tin goods had been unobtainable in this country, and in several cases

large buyers had asked them to make certain articles which would necessitate a considerable increase in their plant and premises. The buyers were at present willing to pay a fair price, but none of them would give contracts for a lengthy period, or guarantee to continue their business when the war was over. Until an adequate measure of protection was afforded, there would be no whole-hearted response by English manufacturers to the appeal to compete with Germany.

Dr. E. F. ARMSTRONG thought the war had given the younger members of the Society a great opportunity to assert themselves. He deprecated the prevailing custom of appointing committees akin to Royal Commissions as leading to very little constructive progress, and urged that the Society should make greater use of its young and active members.

He emphasized the need of research in industrial chemistry, and drew attention to such recent achievements in applied chemistry as the production of artificial silk and of synthetic ammonia as illustrating, firstly, the practical value of such research, and secondly, that English chemists were quite able to take their part in it. He claimed that the industries in which Britain was still pre-eminent were those in which the best procurable technical staff was employed, and which kept their knowledge up to date. On the other hand instances could be cited, particularly in Lancashire, where the technical staff had been neglected and the industry ruined by German competition. The large German firms had gone very far in writing off part of their profits and putting this money into research, and this policy had paid them many times over.

Manufacturers of all kinds should be made to realise what they stood to gain by employing fully trained chemists. Half-trained men by themselves were of very little value, and the Universities must give the industry their best men. They would lose the confidence of manufacturers if they turned out a mediocre product, and they had suffered in the past because they had done this. There was a great chance, particularly for the Northern Universities, to produce the really practical, well-informed, diligent, and modest type of chemical engineer.

Mr. W. P. THOMPSON mentioned some cases he had come across lately illustrating the loss many English firms incurred from never employing an expert chemist. In one case a firm had been paying for years to have a waste product removed from the works, but careful examination had resulted in its being sold recently at £5 per ton. In another case the manufacturer had declared that everything to be known about their product was known.

Dr. ALLMAND agreed with the Chairman that the question was, in its broadest sense, bound up with the type of technical chemist produced by the Universities. Whilst the English Universities produced men as well trained in every way as did the German Universities, little or no attempt was made to turn out men similar to those produced by the German Technical High Schools—namely, chemical engineers. He thought the newer English universities should teach technical chemistry on the broadest possible lines without too much specialisation—general chemical engineering should be the basis of the course. Such a method would be more suitable to English conditions than the way adopted at Leeds (specialisation under experts in one or two branches) or at the Massachusetts Institute of Technology at Boston (short courses on a large number of special subjects). He was convinced that chemists of that type were just as much wanted as men with a more purely theoretical training, and would be welcomed by chemical manufacturers.

Mr. H. E. POTTS said that an important factor in determining the supremacy of Germany in the fine chemical industry was the extraordinarily close network of patents; he had found in some cases as many as twenty patents dealing with one or two drugs alone. Possibly that was not the cause of German success but only a symptom of it; still British manufacturers would not have much chance till they adopted similar measures. It was true that the working clauses of the 1907 Patents Act had attacked the problem, but after all, in the case of fine chemicals, did it matter very much where they were made? In any case the labour employed was practically negligible compared to the cost of the materials and expert supervision and research. Further, the various steps in the manufacture of a complicated drug might be covered by separate patents, and possibly only the final stage worked in this country. For example, salvarsan was manufactured in this country only so far as the final stage was concerned, i.e. the reduction of the *p*-hydroxyaminophenylarsinic acid to dihydroxydiamino-arsenobenzene. The intermediate product was imported from Germany. The remedy appeared to be rather in the direction of easy compulsory licenses, to enable British manufacturers to obtain a share of the business, than in the direction of compulsory working by the patentee. This latter often merely meant that a works was established here to carry out an illusory working sufficient to satisfy the law. A step had already been taken in the former direction by the present Government in their Temporary Act to deal with patents held by alien enemies. Mr. Potts then proceeded to explain the provisions of this Act in some detail, giving actual examples from his own experience before the Comptroller of Patents (see this Journal, 1914, pp. 813, 847, 899, 1037, 1118.)

Mr. G. CARRUTHERS THOMSON said that, looking back on his own experience in engineering, it seemed to him that what was wanted was a little more enterprise and foresight among the manufacturers. Unless they had a good head draughtsman with a good staff in the drawing office, they would not do well in the works. Likewise in the chemical industry, unless the manufacturers had a good head chemist in their scientific department, they were not likely to do well in their factories and could not do much in the way of improvement. More education of the manufacturers was wanted. A great many had the means but not the will to employ and pay for the brains; but that was often caused by ignorance of the value of men with brains and skill to the business. Again in the chemical industry, the engineer with a knowledge of chemistry was not appreciated as he ought to be, to assist the works manager and chemist in bringing to a successful issue the processes required to make profitable the discoveries and improvement made by the scientific department. The engineer should be one with a knowledge of chemistry and not a chemist with a knowledge of engineering.

Prof. BALY felt that it was too much to expect a chemist also to be an engineering expert. High efficiency in both sciences appeared to be too high an ideal to look for in any one man. He suggested that what was really needed was that the two types should be attached to the staff of the works, the research chemist and the engineer. Each of these men should know a little of the other's subject so that they would be able to meet and discuss problems without either of them being entirely ignorant of the other's field. The modern training of both types of men was very severe, and it was not possible that any one individual could become proficient in both. The right method to adopt was to give both men a sympathetic understanding of each other's work and

that both should be attached to the staff of every progressive manufacturer.

New York Section.

Meeting held at Rumford Hall, Chemists' Building, on Friday, November 20th, 1914.

MR. G. W. THOMPSON IN THE CHAIR.

TITANIUM AND ITS EFFECTS ON STEEL.

BY GEORGE F. COMSTOCK.

(Abstract.)

Titanium is widely distributed in the earth's crust in small quantities and is always found as an oxide, its principal ores being rutile, the fairly pure dioxide, and ilmenite, a mixture of iron and titanium oxides. One of its chief peculiarities is the readiness with which it combines with nitrogen. It is one of the very few elements which will "burn" in an atmosphere of nitrogen. Its dioxide is one of the most stable compounds known, and great energy is required to decompose it. Thus it follows that when titanium is separated from its oxygen, it will readily re-combine with it, with evolution of heat. The value of titanium in the steel industry is due largely to the fact that its dioxide is so much more stable than iron oxide that its action in "deoxidising" melted steel is very powerful.

The reduction of the natural oxides is effected either by reduction with carbon by means of the electric arc, or by an aluminothermic reaction. The former process delivers the titanium in the form of a carbide, while the latter produces an alloy of titanium, aluminium, and iron. The carbide is the form most generally used.

Metallic titanium when heated to redness in nitrogen forms titanium nitride, but when heated in air only the oxide is formed. The nitride is slowly converted to the oxide when heated to redness in air, but the carbide burns vigorously in air, forming dioxide. The reverse reaction takes place only at very high temperatures. Even at the temperature of the blast furnace titaniferous ores do not give more than 1% of titanium in the pig iron. This is probably present partly as carbide and partly as cyanonitride. Although in the blast furnace titanium nitride is sometimes formed, it is not present in the titanium-carbide alloy used in treating steel, for at the temperature of the electric arc furnace, in which this alloy is made, with a reducing atmosphere and excess carbon, the nitride is dissociated in favour of the carbide.

For general effectiveness titanium is the best of the various deoxidisers for steel. The carbide gives results quite as good as the pure metal and is much cheaper. A material is sold at 8 cents per lb. containing 15 to 20% Ti, and known as "Ferro Carbon-Titanium." It consists of microscopic particles of titanium carbide held in a matrix similar to grey cast iron. When added to melted steel the matrix dissolves quickly, and the particles of titanium carbide are rapidly diffused through the bath, where they react vigorously on the oxygen.

The aluminothermic alloy, which contains very little carbon, is an alloy of aluminium and titanium in iron, and hence its use involves the production of the effects of both these elements. The chief

objection to its use is the harmful effect of aluminium in hindering the removal of oxide and slag enclosures.

Titanium oxide acts as a flux for silicates and other slags that may be in the steel. The best cleansing action is obtained when the titanium is added without aluminium, or in the form of the carbide rather than as the aluminothermic alloy. The latter should only be used in the few rare cases where the addition of the carbon of the alloy would be undesirable. In soft steels the increase in carbon from this addition would not be more than about 0.01%, so that the cases where this would make any material difference are very few indeed. Practically all the titanium used in steel in America at the present time is in the form of ferro carbon-titanium, a large percentage being used for rail steel, although its use in other steels is growing steadily.

"Titanium steel," properly speaking, is not made commercially at present. Such a title naturally implies a steel whose properties are dependent to an appreciable extent on a certain content of titanium. The advantages of the titanium-treated steels as made to-day are due to greater soundness, cleanness, and less segregation, and not, as far as is known at present, to the small amount of titanium left in the metal. In no case has over 0.025% of titanium been found in any sample of titanium-treated steel analysed at our laboratories. It is very difficult to make steel absorb more than 0.025% titanium under the usual conditions of manufacture, and no use has yet been found for steel containing larger quantities that would warrant the attempt to produce commercially a real "titanium steel."

Steels made by the Bessemer, open-hearth, or crucible processes are treated with titanium, but most of this element is used in open-hearth steel. The alloy is furnished in various sizes, from lumps of about 1 in. diameter to powder, according to the quantity of steel to be treated at one time, and for the best results it must be added to the melted steel as it flows from the furnace to the ladle. After the addition the steel must be kept in the ladle for from 3 to 10 minutes, depending on the size of alloy used and the mass of steel treated. Then the steel is teemed as usual into the moulds where no further additions should be made. The amount of alloy recommended for use in rail steel is 13 lb. per ton, which means an addition of 0.1% of metallic titanium. A higher grade alloy is not used because its rate of solution in the melted steel is slower. The price of rails treated in this way is increased about 5%. For castings and soft steels a smaller amount of alloy may be added. Low-carbon steels always contain blowholes even if treated with titanium, but the steel being normally cleansed by the titanic oxide, they are free from slag and are closed up when the ingots are worked. If they become oxidised, however, or contain slag, they will open up, as seams or remain as slag inclusions in the metal. It is well known that if steel is completely deoxidised and no blowholes are formed, a large shrinkage cavity, or "pipe," will form in the centre of the upper part of the ingot. Titanium may cause piping, as well as other deoxidisers, but by properly designing the moulds piping may be controlled so as not to give much trouble.

The dependence of segregation on deoxidation is less obvious than that of soundness. Primarily, segregation is due to selective freezing. The freezing-point diagram of the iron-carbon alloys shows that with ordinary steel the first metal to freeze is of lower carbon content than the remaining liquid, and the last liquid to freeze is of higher carbon content than the already frozen solid. But with well-deoxidised steel this selective freezing takes place in a quiet mass of pasty

material, and the higher-carbon liquid is so intricately entangled in the lower-carbon solid that it does not have chance to gather in the centre of the ingot to any great extent, and is finally frozen together with the lower-carbon material. If this steel is not well deoxidised, but gives off gas during solidification, the gas rises and opens up passages through the steel, taking with it a little of the higher-carbon liquid towards the top and centre of the ingot and leaving the solid lower-carbon material behind. This action will result in the formation of a large body of higher-carbon material in the upper part of the ingot, or, in other words, there will be excessive segregation. Phosphorus is subject to this action in the same way as carbon, and sulphur, existing in the steel as small non-metallic globules composed of a mixture of iron and manganese sulphides with a freezing point not much, if any, higher than that of the metal, is even more affected. For this explanation of the relation between segregation and oxides in steel the writer is indebted to Mr. N. Petinot, Metallurgist of the Titanium Alloy Manufacturing Co.

Aluminium and probably also vanadium and silicon have an effect on segregation similar to that of titanium, but with vanadium the cost would be higher, and with silicon and aluminium impurities would be added to the steel. In most rail steel that has been properly treated with titanium, very small, hard, angular pink inclusions can be found with the microscope. These are titanium nitride, possibly contaminated with carbide. An average of many nitrogen determinations on titanium-treated rails shows a distinctly lower amount present in solution in the metal than in untreated rails. If it is assumed that nitrogen has an injurious effect on steel, the lower amount must be an advantage, for even if the whole amount removed from the metal itself is still present in the pink inclusions, it could have no more ill effects in this form than any other non-metallic inclusions of the same size. As the titanium nitride inclusions are never found segregated in groups or streaks, like alumina and silicates, but are always very small and thinly scattered, their weakening effect on the metal is practically negligible. They have been found in titanium-treated steel axles as well as rails, but not in steel castings or soft steels, where smaller amounts of titanium have been used.

Some so-called "titanium-treated" steels have not been any better in regard to segregation than the average untreated steel. These have constituted, however, an insignificant percentage of the total number examined in these laboratories. In every case these segregated "treated" rails have not shown a titanium content of over 0.005% (while the average treated rails are well above that figure), and the pink nitride inclusions have also been absent. These facts indicate that not enough titanium was added to produce the usual effects. In the case of deoxidation of steel with titanium an excess of probably at least 0.005% is necessary.

Forty-two samples of plain and treated open-hearth steel rails have been exhaustively tested, physically and chemically, in these laboratories. The samples have all been taken from the "A rails" or first rails rolled from the ingots, after the usual discards from their tops, thus representing in each case metal from the top part of an ingot, which would show the greatest amount of segregation and impurities. The samples were always taken in pairs, one treated and one untreated from each rolling, so that in the final comparison the influence of the conditions of manufacture could be as far as possible eliminated. The final averages of the results are here tabulated.

Chemical analyses were made at four places on each rail—at top of head, centre of head, web, and flange. The lowest and highest figures for each rail were averaged together, giving the average low and high results:—

	Untreated rails.		Treated rails.	
	Low.	High.	Low.	High.
Carbon	0.58	0.82	0.63	0.76
Manganese	0.71	0.78	0.75	0.79
Phosphorus	0.016	0.028	0.018	0.023
Sulphur	0.032	0.053	0.031	0.040
Silica	0.117	0.131	0.090	0.099

The following figures relate to tests on the head of the rails:—

	Untreated rails.	Treated rails.
Elastic limit	50,071	59,738
Ultimate strength	113,133	124,357
Elongation	12.6%	15.1%
Reduction of area	14.9%	15.4%
Brinell hardness	220	223
Impact resistance (Fremont machine)	1.47	1.58
Endurance (A)	1312	1280
Endurance (B)	16,550,920	23,923,623

(A) By Landgraf-Turner machine. Alternate bendings endured before fracture.

(B) By White-Souther machine. Revolutions before fracture.

The improvement in other rails, from lower positions in the ingots, would be much less marked, but the rails that give most of the trouble in service are the segregated "A" rails, and these are rendered practically as uniform and homogeneous as the other rails by treatment with titanium. Titanium-treated rails are not better, probably, than the best possible untreated rail; but by this treatment the general standard of quality is unquestionably raised, uniformity is more nearly attained, and the bad heats of dangerously segregated or dirty steel are avoided.

To acquire still more positive data on the effect of titanium on segregation in rails, 79 "A" rails from different untreated heats and 31 similar rails from different treated heats were examined recently by means of sulphur prints and chemical analyses for carbon made on each at an upper corner of the head and at the junction of head and web. The average difference between these two points was 17% for the untreated rails, and the worst rail showed 40, while only 29 of these 79 rails showed less than 12%. For the treated rails the average difference was 3.1%, and the worst one gave 11.5%, none of the 31 showing over this amount.

The railroads have been acquiring data for some time in regard to the wear of titanium-treated rails in track, as compared with that of ordinary open-hearth rails. The results have been uniformly favourable to the treated rails, in some cases very decidedly so. For instance, on a sharp curve on the Boston Elevated Railway, titanium-treated rails laid alternately with plain rails of practically the same composition showed 41% less wear after 214 days' service. In a test made by the Rock Island Railroad, titanium-treated rails in 17 months had 0.014 sq. in. abraded from their sections, on the average, while electric steel rails showed under the same conditions a loss of 0.058 sq. in., and ordinary rails 0.075 sq. in.

In axle steel it has been found similarly advantageous to use titanium for purifying the metal and preventing segregation. In steel castings the use of titanium as a deoxidiser has usually been successful and satisfactory, and in soft steel for

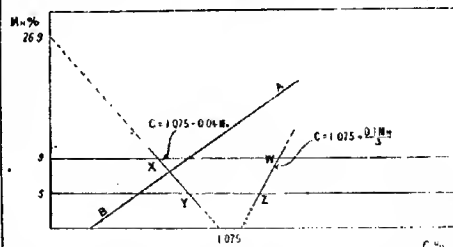
plates and thin sheets much titanium is used. This element is preferred to any other deoxidiser because it does not leave any product of its oxidation in the steel as aluminium and silicon do, and the ingots therefore roll out smoother and the finished sheets have a better surface. Small defects on the surface of a sheet are very serious in galvanizing, so that the smoother surface of titanium-treated sheets, due to cleaner ingots, is much appreciated.

MANGANESE STEEL.

BY JOHN H. HALL.

Composition and characteristics.—Manganese steel was discovered in the early eighties, and was originally made by mixing molten ferro-manganese and carbonless Bessemer blown metal in such amounts as to give various proportions of manganese in the finished product; consequently the ratio of manganese to carbon was practically fixed. With less than a certain amount of manganese, the metal proved to be extremely brittle, and in practice the manganese was seldom less than 9%, the steel generally containing 10 to 14% of manganese and 1 to 1.5% of carbon. The silicon is generally from 0.2 to 0.5%, the sulphur is always very low, about 0.001%, and the phosphorus averages from 0.08 to 0.1%. Small variations in the silicon and phosphorus have little effect on the properties of the steel. The sulphur is invariably low, because the manganese of the steel eliminates it by flotation as MnS . By heating this steel to between 1000° and 1100° C. it can be made, if not of too heavy a section, to consist entirely of austenite.

More recent researches, in some of which the author has participated, have shown that if the carbon content of the metal is maintained at about 1%, the steel will be austenitic after quenching, even if the manganese content is as low as 5% or even a little less; the range of carbon content



within which pure austenite can be obtained is narrow with low manganese content, and widens as the manganese increases. This can be more readily understood by reference to the accompanying diagram, showing part of the manganese steel series, in which the carbon content is plotted as ordinate and the manganese content as abscissa. Within the area WXYZ the steel consists of pure austenite when quenched. Steels immediately to the left of the line $C = 1.075 - 0.04 Mn$ are more or less martensitic when quenched; those immediately to the right of the line $C = 1.075 + \frac{0.1 Mn}{3}$ contain free cementite when quenched, the amount of cementite increasing as the carbon content rises. This is true also of the prolongations of the lines for a certain distance. These lines were plotted as the result of a careful research, having for its object the determination of the useful range of manganese content in these steels. The line AB represents roughly the contents of carbon and of

manganese of the steels forming the basis of the original discovery and patent. The reason why the steel was found to be martensitic and brittle when the manganese was still comparatively high is apparent at a glance. The well-known diagram of Guillet, showing the micro-structure of the steels of the non-carbon manganese series, is not parallel to this diagram, as Guillet's figure represents the steel in the normalised condition; whereas in this figure, the structures are that of the steel in the quenched state.

Properties of the steel.—Manganese steel has a very low conductivity for both heat and electric current, a low melting point (about 1360° C.), a very high coefficient of expansion (making necessary a shrinkage allowance of 5/16 in. to the foot in foundry work), and is practically non-magnetic in all ordinary conditions. When cast it is very brittle. The cast material after heating to about 1080° C. and quenching has only a moderately high tensile strength, about 60,000 to 80,000 lb. per sq. inch, a rather low elastic limit in both tension and compression, and a rather high ductility; its shearing strength is remarkably high. When rolled or forged and treated, the tensile strength is increased very greatly, sometimes reaching 150,000 lb. per sq. inch, and the ductility much improved; the other properties are not much altered. The rolled material, if untreated, is quite brittle.

The chief characteristic, to which the metal owes its usefulness, is its hardness. In the treated state in which the steel has to be used, this hardness is of a peculiar kind, since, owing to its low elastic limit, the metal can be made to pean or flow when cold under the blows of a hammer to a considerable extent. In a way, therefore, the steel is soft; and hardness tests, which depend upon indenting the material, do not give high figures. Unless specially heat-treated, however, it cannot be cut with tools to a sufficient extent to make machining practicable, and its resistance to most kinds of wear is extraordinary.

As the manganese content is reduced, if the carbon be kept at the proper figure, the properties change much less than was originally supposed. The strength falls off a little, the toughness diminishes progressively, and the magnetism increases a little. The resistance to wear is very little altered as long as the manganese is kept above about 5 or 6%, and the tendency to pean or flow decreases as the manganese content diminishes. The usefulness of these low manganese steels is, however, rather limited by their comparative lack of toughness; they are not very brittle, like the martensitic steels of the same manganese content, but they are not nearly so tough as the steels containing over 10% of manganese.

Uses.—Manganese steel is very widely used for the wearing parts of stone crushers and rolls working on hard rock, for the lips and teeth of steam shovels and ladder dredges handling rock or gravel, for centrifugal pump cases and flyers, handling gritty water, for stone screens, coal cracking rolls, drive chains exposed to grit, and other service of a similar nature. For railroad and trolley frogs, switch points, crossings, etc., the cast material is very widely used, and for rails laid on sharp curves manganese steel is almost indispensable. These rails were formerly all of cast material, but are now very generally rolled from ingots. Its tendency to flow or pean under heavy loads prevented its being used for railway car wheels. Under light loads in mine and quarry cars, blast-furnace charging barrows, etc., it is widely used. The tendency to flow or pean has limited the usefulness of the metal also for tyres in such grinding mills as the Fuller and Griffin, and for the lining plates of the various forms of ball mills. It has long been widely used for lining plates in ball mills used in the manufacture of cement, but in many other cases it has proved to pean too much to make it

use possible. In some cases, as for instance for certain sorts of grinding mill tyres, the use of a steel of lower manganese content, which peans less, overcomes the difficulty; the general application of these low manganese steels to this field is, however, prevented by their lack of toughness.

Manufacture of the steel.—The simplest and cheapest way to produce manganese steel is to mix together molten 80% ferromanganese and molten soft steel containing from 0.10 to 0.25% of carbon. The carbon content of the ferromanganese is such that the steel produced is of the correct composition for most purposes. The steel is seldom made by the crucible process, on account of the cost and of the difficulty of obtaining low-carbon steel by that method.

The open-hearth furnace can be used to produce the soft steel required, but the small Bessemer converter has many advantages and is more widely used. It makes cheap metal, though not quite as cheap as the basic open-hearth furnace; it provides small lots of metal distributed over the day; it does not have to be run double turn, and the cost of shutting the plant down for several days in the week is not nearly so high as with the open-hearth furnace. The Bessemer metal is not as good as open-hearth, because it is more highly oxidised, but the enormous addition of manganese will deoxidise it almost completely, and most manganese steel castings do not require better metal than can be made in the Bessemer converter.

The scrap produced, which amounts in most small foundries to 40 or 50% of the fluid metal, must for complete economy be remelted. This can be done in the open-hearth furnace, although if but a single furnace is available, and the chief product is manganese steel, metal containing a great deal of manganese produces a slag which cuts into the bottom of the furnace severely. In the small hot-bottom-blown Bessemer vessel, most of the scrap produced can be used by melting it with the pig iron in the cupola. The resulting high-manganese metal can be successfully blown by taking proper precautions, the practice being similar to that in the Swedish Bessemer shops, where pig iron containing a high proportion of manganese is frequently blown. In the side-blown converter it has so far been practically impossible to blow these high-manganese mixtures. Within the last year or two the author has conducted some experiments hearing on this problem with some success, and he hopes and expects that the problem will be solved satisfactorily within the next few years.

If the scrap is remelted in the open-hearth furnace, or remelted in the cupola and blown in the Bessemer converter, all the manganese is oxidised and lost in the slag. The yearly loss represented by this oxidised manganese amounts to a considerable sum. The most obvious solution of this problem is to melt the scrap in the electric furnace, which can be done almost without loss of manganese. In practice, however, the saving, as compared with remelting and blowing, is not very great, especially in shops already provided with a Bessemer equipment sufficient for their needs, because if an electric furnace is added to remelt the scrap, the output of the Bessemer equipment is cut down, and hence the cost of the steel made in it is raised. For this reason the electric furnace has not so far proved so useful in the manufacture of manganese steel as its inventors hoped. To make electric steel cheaply, moreover, it is necessary to use a furnace of considerable size and to keep it running continuously. This is a condition not well suited to the average manufacturer of manganese steel castings.

Melting the ferro-manganese.—As the total weight of ferro-manganese needed for the production of manganese steel is roughly one-fifth of the weight of the blown metal, it is essential that the ferro-manganese be melted. For many years crucibles

have been used for the purpose, in spite of the fact that this method is more expensive than any other. The great advantage of crucible melting is that the melting losses are relatively slight.

Efforts have been made with more or less success to melt ferro-manganese in the cupola furnace. The use of this very cheap melting method has, however, not become general, because the melting losses are very high even when special precautions are taken, and these precautions necessarily complicate the operation of the cupola. The air furnace and even this small open-hearth furnace have been used to a certain extent for melting ferro-manganese, but have not been generally adopted because the melting losses are high, and, in the case of the open-hearth furnace, because night work is not commonly desirable.

The electric furnace has often been suggested as the best method of melting ferromanganese, and is being used to an increasing extent in foreign steel works making ordinary steels. It has certain disadvantages for the maker of manganese steel in large quantities. The first is that the total melting capacity of the furnace must be high, and this necessitates the installation of one or two large furnaces. The first cost of the furnaces is high, and to keep them idle at night involves a very considerable loss. The second disadvantage is that a large bath of metal has to be melted down and drawn off a little at a time, since the furnace will not melt the metal as fast as it is needed; hence a considerable expense has to be incurred for current. In many cases, therefore, it does not pay to instal an electric furnace for melting ferro-manganese, unless it is used at night for melting manganese steel scrap; this necessitates pouring at night, which does not suit the ordinary small foundry; and in some cases the electric furnace will be found profitable in an existing shop only when the existing melting capacity must be increased, as it would not pay to use it if the output of the original equipment was correspondingly reduced.

Moulding methods.—The differences between manganese steel foundry practice and ordinary steel practices are due to the greater shrinkage of manganese steel and its low melting point and great fluidity. The latter properties enable the maker to obtain sound castings in many cases with less waste of metal in sink-heads than would be possible with ordinary steel. Chills are very extensively used to assist the action of the sink-heads, and the heads themselves are often almost completely drained, leaving a mere shell of metal. The great shrinkage and the brittleness of the steel in this cast condition, greatly increase the tendency of the castings to crack in cooling in the moulds. The moulds and cores often have to be broken up while the casting is still hot, and the castings often have to be cooled slowly, either by burying them in sand or by placing them when hot in a hot furnace, where they are allowed to cool slowly and evenly. Many of the castings also have to be freed from sand and placed in the treating furnace whilst still hot, to prevent cracking. The great tendency to crack also necessitates the utmost care in this design of the casting to avoid great variations in section between different parts.

Heat treatment.—Manganese steel is heat-treated by heating it to between 1000° and 1100° C. and cooling rapidly in cold water. Naturally this very drastic treatment frequently results in the cracking of the casting, so that unevenness of section must be avoided as far as possible. Moreover, the low heat conductivity of the metal and its high coefficient of expansion make this heating of the castings in the treating furnace a delicate matter. If they are heated too rapidly, the outside of the heavy portions and the whole of the lighter parts outstrip the interior of the heavy sections very

greatly, much more so than in the case of ordinary steel. The great expansion of the steel gives rise under these conditions to very heavy stresses, and as the steel in this cast condition is extremely brittle, these stresses are almost certain to result in the cracking of the casting. Hence heavy and complicated castings of this steel have to be heated up extremely slowly.

Rolling and forging.—For many years the problem of the rolling and forging of manganese steel was only partly solved, and many rolled shapes were made, not from an ingot, but from a cast blank which approximated this shape of the finished product. To-day, however, large ingots are successfully rolled into rails and other shapes. It is generally essential that the ingot be rolled or hammered at first very lightly all over and returned to the heating furnace before much reduction of size is attempted. The ingots are successfully brought to rolling temperatures which it was formerly thought could not be attained without risk of the ingots crumpling under the hammer or in the mill. The range of temperature within which the steel may readily be rolled is not very wide, since if it is heated too highly it will crumple, and if it is too cool it will burst the housings of the rolling mill. The heat treatment of the rolled steel is the same as that of this cast material. Frequently, however, the shape is finished slightly above the proper temperature for quenching, and is introduced into the tanks of water without reheating. Very even sections, whether cast or rolled, can be made quite tough by cooling in the air, since the toughness is roughly a function of the rate of cooling.

Metallography.—In the cast condition manganese steel consists of a ground-mass of austenite, containing manganiferous cementite in a net-work, and many needles and small lakes within the austenite grains. These cementite lakes and networks are bounded by a zone in which the austenite is more or less transformed to troostite or sorbite. There are also places where the cementite and partly transformed austenite form an eutectic. The higher the carbon the greater the quantity of this eutectic.

On heating to the treatment temperatures, the cementite is absorbed in the austenite, and is not liberated on cooling if the cooling be sufficiently rapid. In a thin bar cooled in the air there will be but little cementite liberated. In a heavy section there will be a considerable formation of cementite in the interior even after quenching, because the interior cools too slowly to restrain the separation of cementite. Hence, heavy sections cannot be made as tough as light sections, and there is a distinct limit to the thickness of manganese steel castings which it is practicable to manufacture.

If the steel is cooled slowly from the treatment temperature, the cementite is liberated in a structure more or less resembling that of the cast material. The temperature at which cementite begins to be liberated, however, is several hundred degrees lower than that at which the last traces of it are absorbed in heating. Hence the castings may be allowed to cool considerably in the furnace or in the air on this way to the tank, and yet will be quite tough after quenching; but if they are very heavy, more cementite will be liberated in their interior portions than if they had struck the water at the maximum temperature. Hence the larger the casting the more care must be taken to prevent its cooling off before quenching.

If the quenched steel be reheated to a comparatively low temperature, its toughness is almost completely removed. This is largely due to the liberation of cementite from the austenite at about 500° C., in a very fine net-work, and in countless little needles distributed broadcast through the austenite. These needles break up the continuity

of the austenite, which is no doubt also partially transformed, so that the steel becomes very brittle. This brittleness, in fact, is greater than that due to cooling in the air from the treatment temperature, so that if a bar of the toughened steel be reheated at one end to a white heat and cooled in the air, it will generally break when struck with a hammer at the point where it was at or slightly below red heat. The maker of manganese steel is much troubled by claims for castings which have broken when the users heated the metal in order to bend or work it. Frequently the casting breaks quite a distance from the spot where it was heated, and it is then difficult to convince the customer that it was the heating which caused the damage, but microscopical examination will prove the case beyond doubt.

If heated for 24 hours or more to 500°–600° C. the steel becomes very brittle, strongly magnetic, and very much softer as tested by the drill than in the cast or treated condition, although its Brinell hardness figure is raised. This treatment results in the transformation of the austenite to sorbite, and if the heating were sufficiently prolonged transformation to pearlite would no doubt occur. If the steel is immersed in liquid air, its magnetism is increased. On reheating this magnetic material, a critical point is found at about 730° C., accompanied by loss of magnetism. If reheated to the quenching temperature and quenched the metal is austenitic and tough, but if cooled slowly it will be brittle and will show the same micro-structure as if it had never been made magnetic.

The controversy which is now raging as to the existence of β -iron has involved manganese steel, and much new data has been published on the behaviour of manganese steel in heat treatment. It has long been claimed by some that there are features in the behaviour of manganese steel which the allotropic theory will not explain. I personally have not yet found a treatment of the metallography of manganese steel which the allotropic theory fails to explain. In fact, when I first investigated the metallography of manganese steel I was able to save myself a great deal of labour by using the carbon-iron diagram and the allotropic theory as a guide.

Nottingham Section.

PRESENTATION TO DR. H. J. S. SAND.

At a meeting held at University College, Nottingham, on Dec. 9th, 1914, Dr. H. J. S. Sand, late Secretary of the Section, was presented by the members of the Section with a handsome clock, in appreciation of his services during his tenure of office. The chair was occupied by Mr. L. Archbutt, in the unavoidable absence of Mr. John White, Chairman of the Section.

Mr. ARCHBUTT, in making the presentation, tendered to Dr. Sand the very hearty thanks of the Section for all the work he had done for them during the four years of his Secretaryship, particularly mentioning his successful efforts on the occasion of the Annual Meeting of the Society in July, 1914. He thought that it was a great credit to the Section and to its officials that they had been able to keep together for so many years, in spite of having only about 70 members, amongst whom there was an unusual diversity of interest. The association of the Sections with University Colleges was most valuable.

Mr. J. T. WOOD endorsed the Chairman's remarks, and said he knew from experience how arduous were the labours of a Secretary in obtaining suitable papers for the meetings.

Dr. SAND very warmly thanked the Chairman and the Section for their expressions of appreciation and for their very handsome gift to him. The Society, through its Sections, was doing a very good work in bringing together those connected with widely differing branches of chemical industry, and he valued very highly the friendships which he had made during the time he had been connected with the Section.

Scottish Section.

Meeting held at Glasgow on Tuesday, 24th November 1914.

MR. ROBERT HAMILTON IN THE CHAIR.

NOTE ON THE MELTING POINT OF 1,2,4,6-TRINITROTOLUENE.

BY WILLIAM RINTOUL.

Considerable discrepancies exist between the observations of different workers with regard to the melting point of trinitrotoluene. The following are some of the determinations which have been published from time to time:—

Pure Trinitrotoluene.

Observer.	Reference.	Melting point, °C.
Wilbrand	Annalen, 1863, 128, 178	82
Mills	Phil. Mag., 1875, [4] 60, 17	78.85
Brunswig	"Explosivstoffe," 1909, 149	80.54 81.5
Corney	J. Ind. Eng. Chem., 1910, 103	80.5–80.6
Vasquez	Mem. d'Artillerie, Sept. 1910	80.6
Milani	"Explosifs en Italie," 1913, 170	80.4
Molinari and Giua	"Explosifs en Italie," 1913, 170	80.65

In view of the differences recorded above, it was considered desirable to carry out some experiments in order to determine the true melting point of this substance.

A full-sized manufacturing charge of the highest grade of commercial toluene, having a distillation range of less than 0.5° C. was nitrated with well-settled commercial acids. The resulting product was fractionated by distillation *in vacuo* and by re-crystallisation. In this way, a quantity of *p*-nitrotoluene of a high degree of purity was obtained, which showed a melting point of 50.8 to 51.8° C.

A quantity of this material was re-crystallised repeatedly from pure absolute alcohol until no difference in melting point could be detected between the crystals separated from the last crystallisation and the residue obtained on evaporating the mother liquor of that crystallisation to dryness, one additional crystallisation being carried out after this point had been reached. The following results were obtained:—

Crystallisation.	Melting point of crystals.	Melting point of residue from mother liquor.
	°C.	°C.
1	51.6–51.9	50.1–51.2
2	51.6–51.9	51.6–51.8
3	51.6–51.9	51.6–51.9
4	51.6–51.9	51.6–51.9

From these figures it would appear that the true melting point of *p*-nitrotoluene is 51·6—51·9° C.

The following figures for this constant are to be found in literature :—

Melting point of p-nitrotoluene.

Observer.	Reference.	Melting point.
Jaworsky	Zeit. f. Chemie, 1865, 223	°C. 54
Rosenstohl	Beilstein (II), 1896, 92	52
Beilstein u. Kuhlberg	Comptes Rend., 70, 260	54
Neubeck	Annalen, 155, 1	54
Auwers	Z. physik. Chemie, 1887, 1, 659	54
Hollenman-Walker	Z. physik. Chemie, 1899, 30, 310	50·5—52
	"Org-Chem." 1903, 366	51

The pure *p*-nitrotoluene obtained from the fourth crystallisation referred to above was nitrated to dinitrotoluene with a mixed acid prepared from chemically pure sulphuric and nitric acids. The resulting product was purified by boiling with water and careful neutralisation. The dinitrotoluene obtained had a melting point of 69·5 to 70·0° C. This material was purified in exactly the same way as in the case of the *p*-nitrotoluene described above with the following results :—

Crystallisation.	Melting point of crystals.	Melting point of residue from mother liquor.
	°C.	°C.
1	69·6—70·0	62·3—65·4
2	69·7—70·0	63·1—70·0
3	69·9—70·2	69·4—69·9
4	69·9—70·2	69·9—70·2
5	69·9—70·2	69·9—70·2

The melting point of 1,2,4-dinitrotoluene is therefore 69·9—70·2° C.

From the pure 1,2,4-dinitrotoluene prepared above, trinitrotoluene was prepared by nitration in the usual manner, chemically pure nitric acid and oleum of as high a degree of purity as could be obtained being used. The product from nitration was purified by washing with distilled water and careful neutralisation. The melting point of this trinitrotoluene as prepared was 79·5°—80·0° C., and constituted the final raw material from which the preparation of the pure trinitrotoluene was carried out.

The separation of chemically pure trinitrotoluene from the crude material was attempted in several ways, namely, by crystallisation from sulphuric acid, by crystallisation from pure alcohol, by crystallisation from pure benzene, and by fractional precipitation from acetone.

These preliminary experiments showed that the most efficient means of purifying the commercial material was by crystallisation from alcohol or from benzene. It was decided therefore to employ crystallisation from both these solvents as a means of obtaining the trinitrotoluene in a pure form.

The purest material which had been obtained from the alcohol crystallisation was fractionated, by a further re-crystallisation from alcohol, into a number of fractions, and these fractions were continuously fractionated three times, the second and succeeding fractions being dissolved in the mother liquor of the preceding fractions. The material giving the highest constant melting

point after the third continuous fractionation was then fractionated into several portions from benzene solution, and these portions were in turn continuously fractionated three times.

In the same way, the trinitrotoluene which had been prepared from the crude material by four crystallisations from benzene was continuously fractionated from benzene and then from alcohol.

With the pure materials obtained as described above, accurate melting point determinations were carried out. The apparatus used for these determinations was similar to the thermometer standardising apparatus used at the National Physical Laboratory and described in their Annual Report for 1908. The thermometer used was graduated in tenths of a degree, and had been recently standardised by the Reichsanstalt. The melting point tubes used were from 40—50 cm. long and about 1 mm. or less in internal diameter.

The trinitrotoluene to be tested was carefully dried by gently warming for one or two hours. The tubes containing the material were introduced into the bath at a temperature of about 80° C. and the temperature was gradually raised to 80·4° and kept as nearly as possible at that temperature for 20 to 40 minutes. The temperature was then raised 0·05° at a time, and maintained as constant as possible for a definite interval of time, usually about 30 minutes. Observations were taken at the end of each interval of any changes which had taken place during that particular period. This procedure was continued until every particle of the material under test had been completely melted.

Five of the samples of purified trinitrotoluene resulting from the third continuous fractionation from benzene were submitted to this accurate method for the determination of the melting point, the first fractionation being omitted owing to the small quantity obtained. The following results were obtained :—

No. of fraction.	First indication of softening.	First indication of melting.	Completely melted at
	°C.	°C.	°C.
2	80·55—80·60	80·70—80·75	80·75—80·85
3	80·45—80·50	80·55—80·60	80·70
4	80·65—80·70	—	80·75—80·85
5	80·55—80·60	80·70—80·75	80·75—80·85
6	80·65—80·70	—	80·75—80·85

In the same way, the first four samples resulting from the third continuous fractionation from alcohol were also tested and gave the following results :—

No. of fraction.	First indication of softening.	First indication of melting.	Completely melted at
	°C.	°C.	°C.
1	80·40—80·50	80·55—80·60	80·65—80·70
2	80·40—80·50	80·60—80·65	80·70—80·80
3	80·40—80·50	80·55	80·65—80·70
4	80·40—80·50	80·50—80·55	80·60—80·65

From the above experiments it would appear that the purest 1,2,4,6-trinitrotoluene will liquefy if maintained at a temperature of 80·85° C. for a sufficiently long period of time, and that the true melting point of this substance lies somewhere between 80·80 and 80·85° C.

The practical work in connection with this investigation was carried out by Mr. J. H. O'Connor and Mr. W. C. Evans in the Research Laboratories of Messrs. Nobel's Explosives Co., Ardeer.

Yorkshire Section.

Meeting held at Queen's Hotel, Leeds, on Monday,
November 30th, 1914.

MR. F. W. RICHARDSON IN THE CHAIR.

THE OXIDATION OF OILS AND OF FATTY ACIDS.

BY J. HYLAND AND L. L. LLOYD.

Owing to the production of partially hydrogenated oils, having chemical and physical values practically identical with those of olive oil, which are being placed on the market as a substitute for olive oil for use in the worsted trade, etc., an attempt has been made to discover some test by means of which these oils could be valued. Some hydrogenated oils have been placed on the market that have an iodine value practically the same as that of olive oil, but which, unlike olive oil, gradually become tacky when exposed in thin films to moist air, such as oiled tops, etc.

From the communication by Hird and one of us, on the action of sulphur dioxide upon oils (see this J., 1912, 317), it appeared possible to obtain a quantitative production of sulphuric acid by the action of sulphur dioxide and oxygen upon oils for a definite time at constant temperature. We have been able to obtain a constant yield of sulphuric acid from certain oils when diluted with several inert solvents. With many oils, however, particularly those that readily char with sulphuric acid, a constant production of sulphuric acid could not be obtained. With genuine pure oils fairly characteristic colour reactions may be observed during the action of sulphur dioxide and oxygen upon them. The colour reactions of the commercial oils vary so much, probably due to other oils having been in the same vessels for transport, etc., that it is of little value tabulating these results.

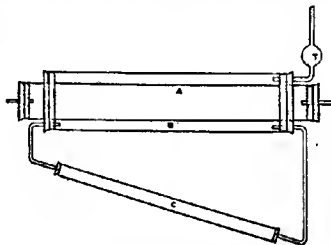
The yield of sulphuric acid by the action of sulphur dioxide and oxygen upon oils is greatly increased in the presence of a drier, the increase varying with the amount and nature of the drier. The order of activity, calculated from the production of sulphuric acid, of the metals which have been tested when dissolved as resins in the oils, is as follows:—Copper, cobalt, manganese, nickel, chromium, and iron. Lead did not assist the formation of sulphuric acid.

It has also been observed that the addition of small amounts of oxidisable oils to the "non-drying oils" greatly increases the rate at which these oils absorb oxygen, thicken, and become tacky. Similarly the addition of oxidisable oils to the "non-drying oils" affects the amount of sulphuric acid formed by action of sulphur dioxide and oxygen. In each of these cases the oxidisable oils apparently act as oxygen carriers or catalytic agents.

Ingle (this J., 1913, 639—641) has shown that with drying oils the amount of oxygen absorbed in dry air is in the ratio $2I = 2O$ or $I_2 = O_2$, but if the air be moist the peroxides thus formed are decomposed with production of volatile compounds—aldehydes and acids; also that the free acids of linseed and other oils only absorb half the amount of that absorbed by their glycerides. The same remarks also apply to their ethyl esters, these only absorbing one atom of oxygen for every two atoms of iodine absorbed. Ingle also showed that the maximum absorption of oxygen by the oils took place in dry air; moisture tends to lower it, and after maximum absorption, loss begins to take place.

We have made similar experiments with the so-called "non-drying oils" that are used in the textile trade for combing, spinning, etc., using both dry and moist air, to find whether they were oxidised to any great extent, and also to see whether the absorption of oxygen at any given temperature is quantitative. From a practical point of view more importance has been attached to the action of moist air, as better representing the conditions under which these oils are used.

Pure oleic acid was prepared from olive oil by means of the lead and barium soaps. Some of this acid, after having dissolved in it 5% of manganese resinate, was exposed in a very thin layer to the ordinary atmosphere. The acid increased in weight very slowly, the maximum being reached in three months. The iodine value was taken before exposure and after the maximum gain in weight. The results are given in the table. The acid although still liquid was very viscous. Attempts were then made to increase the rate of oxidation, using the apparatus illustrated. It



consists of a wide glass tube, A, surrounded by a water jacket, B. The water jacket is connected by glass tubing to the copper tube, C, for heating purposes and is also fitted with a water trap, T. The boats containing the oil, etc., were supported on a strip of plate glass inside the tube, A. A thermometer was also placed in the bottom of this tube. When the water is rapidly boiling in the copper tube, the temperature in the tube, A, remains extremely constant at 97° — 98° C.

A weighed quantity of oil, about one gram, was exposed for oxidation on purified quartz contained in broad platinum boats, the boats containing about 10 grms. of finely powdered quartz which had been purified by repeated extraction with hydrochloric acid, washed, and dried. A piece of thick platinum wire was also weighed with the boat, this being used for stirring the mixture. Air was drawn slowly through the tube, A, by means of an aspirator, about 1.5 litres passing per hour. When dry air was used, it was first passed through a wash bottle containing sulphuric acid and then through two calcium chloride tubes. A calcium chloride tube was also placed between the exit of the tube and the aspirator to prevent diffusion of moisture into the tube. When moist air was used it was drawn through a wash bottle containing water and then through a tube containing cotton wool. The weighed boats and contents, etc., were exposed to oxygenation and were taken out at intervals, dried in a desiccator and weighed. When the maximum had been reached or just as loss began to take place, the contents of the boats were extracted with ether, the ether driven off, and the iodine value taken.

The treatment was at first carried out at 97° — 98° C., but it was soon observed that the products of oxidation were far too unstable at that temperature, and that loss in weight began to take place long before a theoretical increase had been reached.

Other temperatures were then tried, and 50° C. was found to be the highest temperature at which

constant results could be obtained, the oxidation at this temperature being far quicker than at the ordinary temperature. This temperature was consequently used for the experimental work.

the oxidation products of these bodies than those of the free acids. It will be observed from the table that the oils are nothing like saturated when the maximum gain in weight is obtained, the

TABLE I.

Oil and additions.	Conditions of experiment.	Maximum gain in weight, %.	Time.	Calculated iodine equivalent of gain.		Iodine values by determination.		Actual decrease in iodine value.
				O=I ₂	O ₂ =I ₂	Before.	After.	
Oleic acid + 5% manganese resinate..	Ordinary air, cold	5.8	3 months	92.0	46.0	90.8	51.0	39.2
Oleic acid + 5% manganese resinate.	Dry air, 50° C.	4.3	90 hrs.	68.2	34.1	90.8	36.6	54.2
Oleic acid + 5% manganese resinate.	Moist air, 50° C.	4.1	30 hrs.	65.0	32.5	90.8	52.7	38.1
Oleic acid alone	do.	4.9	250 hrs.	77.7	38.8	90.0	40.4	49.6
Ethyl oleate alone	do.	4.8	270 hrs.	71.4	35.7	75.6	40.2	35.4
Ethyl oleate + 5% manganese resinate	do.	4.4	45 hrs.	69.8	34.9	76.5	38.1	38.4
Olive oil alone	do.	5.8	114 hrs.	92.0	46.0	87.9	46.5	41.4
Olive oil + 5% manganese resinate...	do.	5.6	47 hrs.	89.2	44.6	88.9	40.2	48.7

The numbers in columns 5 and 7, and also the numbers in columns 6 and 8, should agree for each separate experiment.

From the above table it will be observed that the increase in weight corresponds in almost every case to $O=I_2$. With oleic acid, however, a theoretical increase in weight is not obtained, which is doubtless due to the fact that the oxidation products are so unstable at this temperature that they decompose and volatilise some time before complete oxidation has taken place, and it is this decomposition which no doubt accounts for the slight irregularity in the results for the oleic acid. The volatility of oleic acid and of ethyl oleate was tested at 100° C. in a current of carbon dioxide; in 15 hours about 0.5% was lost in either case, but at 50° C. no loss was obtained.

The effect of moisture is apparent from the difference in the iodine values of oleic acid and resinate in dry air and the same mixture in moist air. In dry air the reduction in iodine value is 54.2, in moist only 38.1, whereas the difference in the increase in weight would only account for a difference in the iodine value of 3.1, the actual difference being 16.1. The greater reduction in iodine value in dry air than in moist, with approximately the same increase in weight, is probably due to polymerisation taking place more readily in dry than in moist air or to the formation, by addition of water, of dihydroxy compounds, etc. But with the esters, ethyl oleate or olive oil, figures much nearer the theoretical value have been obtained, showing the greater stability of

actual decrease in iodine value being approximately only half the original iodine value, so that the ratio between the increase in weight and the reduction in iodine value is really $O_2=I_2$, and not $O=I_2$. It is highly probable that condensation or polymerisation takes place, the double bonds being thus shielded from oxidation, or that the oxidation products combine with some of the unoxidised compound during resinification.

The experiments in dry air tend to show that complete oxidation is possible, but the present communication only deals with the absorption of oxygen until a maximum gain in weight is obtained; further oxidation is no doubt possible, but is accompanied by loss in weight.

Moist air appears to prevent the complete oxidation of glycerides, the oxidation products having approximately half the original iodine value, whereas with fatty acids moisture actually aids oxidation.

From the knowledge obtained in the above experiments it seemed desirable to compare the liability to firing of oils of different iodine values. The iodine values of a number of oils were determined and these oils were then tested by the Mackey Cloth-Oil Tester; 14 grms. of oil were distributed on the usual amount of cotton wool and allowed to remain in the tester until a dangerous temperature had been reached or until the temperature remained practically constant. The oily "wool" was removed, extracted with

TABLE II.

Oil.	Maximum temperature.	Time.	Iodine value before.	Iodine value after.	Decrease.	Effect on cotton wool.	Remarks.
Cottonseed oil	217	1 h. 25 m.	111.0	75.1	35.9	Charred	Test stopped to prevent firing, etc.
Malaga olive oil	210	4 h. 38 m.	87.9	52.9	35.0	Charred	do.
Sperm oil	102	5 h.	75.6	65.1	10.5	No effect	Temperature was rising extremely slowly.
50% oleine (dark) contd. 41% free fatty acids	106	3½ h.	88.6	67.1	21.5	do.	This was a maximum temperature and remained constant for a considerable time.
Unsataponifiable matter from the 50% oleine	97.2	3 h.	92.9	76.2	16.7	do.	do.
Fatty acids from the 50% oleine...	98.5	5 h.	80.9	67.0	13.9	do.	Still rising, but extremely slowly.
70% oleine contd. 61% free fatty acids	98.5	3 h.	71.8	65.4	6.4	do.	Constant at this temperature for a considerable time.
Unsataponifiable matter from the 70% oleine	96	3 h.	62.1	60.3	1.8	do.	do.
Fatty acids from 70% oleine	99.5	5 h.	77.8	72.1	5.7	do.	Still rising, but extremely slowly.
Oleic acid	209	1 h. 45 m.	90.0	62.5	27.5	Charred	Stopped to prevent firing.
Ethyl oleate	213	5½ h.	75.6	44.8	30.8	Charred	do.

ether, and the iodine values of the extracted oils determined. In those tests where a dangerous temperature was reached the inlet and exit tubes were tightly corked and the vessel cooled as quickly as possible. The results are given in the Table II.

It will be observed that with all of the oils where any considerable degree of heat was produced, it was accompanied by a considerable decrease in the iodine value, while in practically every case the extracted oil was much thicker and darker.

It is well known that an olive oil containing free fatty acids is much more dangerous than one which is neutral. The time for oleic acid to attain a dangerous temperature in the Mackey Tester is short compared with ethyl oleate or Malaga olive oil. Comparing the iodine values of these substances it does not appear that the liability to fire is governed entirely by the unsaturated nature of the oil but also by the constitution of the substances.

The experiments with distilled oleines, with the fatty acids, and with the unsaponifiable matter separated from these oleines, indicate that the iodine value is of little value as a guide to liability to firing. Although firing is due primarily to oxidation, this alone is not the only cause; if it were, then the 50% oleine which gave a decrease in iodine value of 21.5% should have shown a considerable rise in temperature. It is evident that firing is due to some reaction other than oxidation.

Although a high acid content in olive oil aids firing, it appears not so much the mere acidity, as the constitution of the fatty acids, which governs their behaviour. Also it is not simply the oxidisability of the fatty acids, since the 50% oleine oxidises almost as much as the oleic acid and is yet so much safer. It therefore appears probable that the decomposition of the oxidation products plays an important part.

The experiments with ethyl oleate show it to be far safer than the free acid. The previous experiments (those in the tube) show that it oxidises almost as rapidly as the acid; but with the ester an almost theoretical increase in weight is obtained, whereas with the acid decomposition occurs some time before the theoretical increase in weight is reached. This shows that the oxidation products of ethyl oleate are much more stable than those of oleic acid, and this fact, coupled with the results obtained in the Mackey Tester, upholds the view that the production of heat is due to the decomposition of the oxidation products, and that the more dangerous oils are those whose oxidation products are more easily decomposed or polymerised.

Oleic acid is oxidised more readily in moist air than in dry, as is shown in the first table. This no doubt accounts for the fact that moisture increases the tendency of the oils to fire, when on the fibre, and especially those rich in oleic acid.

By comparison of the results obtained with oleic acid from olive oil and with oleic acid obtained from distilled oleine, it appears that the constitution of the oil or acid is of most importance from a firing aspect, and that the change in the properties is due to change of constitution probably brought about during distillation. It appears that with regard to stability not only unsaturation but also the position of double bonds and the influence of steric groups must be considered.

Further work is being carried out upon the oxidation of oleic acid.

DISCUSSION.

The CHAIRMAN stated that the Bradford Woolcombers' Association had tried the use of arachis

oil on "tops" and at first with apparent success, only to discover later that the tops became very sticky. The trial referred to was a small laboratory experiment only, and the result amply proved that arachis oil was a drying oil and was quite unsuitable to replace olive oil as a lubricant for tops. As a result of this laboratory test, arachis oil was never tried on a larger scale.

Prof. H. R. PROCTER quoted several papers published from his laboratory on this subject. One of them (this J., 1898, 1021), on the relation of the constitution of oils to refractive index and specific gravity, showed that both were raised by the presence of double bonds, and also by oxidation, but that the refractive constant, whether calculated by Gladstone and Dale's formula or by that of Lorenz and Lorentz, was lowered by oxidation. The former formula gave a value near 0.5 for all oils, but it was the apparently small differences from this figure which were significant. In their experiments on oxidation (this J., 1905, 1287) the oils were blown in test tubes instead of being exposed in thin films. While such experiments had a technical importance, the only way to obtain precise information was by further study of the chemical constitution of the different oils.

Mr. W. MCD. MACKEY agreed with Dr. Lloyd that the iodine value did not give a reliable criterion as to whether or not an oil was safe from the insurance point of view. One point to be borne in mind when considering the indications given by such an instrument as the Cloth-Oil Tester was that one was dealing not with an oil alone but with the oil in very intimate contact with cotton wool, and there was little doubt that the action between the oil and the cotton had something to do with the result. Thus, if wool were used instead of cotton wool, the action was slower, and it might be useful to make some experiments of the same nature as those of Dr. Lloyd, spreading the oil on an inert substance such as, say, glass wool.

Mr. T. FAIRLEY considered that the very different results obtained by the authors when using dry air, from those obtained when moist air was used, were due to the presence of moisture, which gave scope for bacteria to start the heating process. In every case where a cargo of wool from Australia had been shipped in a wet condition, a case of spontaneous combustion had arisen. The raw wool contained about 33% of fatty matter. The same applied to cotton shipped in a wet state. He had made experiments with both cotton wool and wool, and as might be expected there were great differences. Raw wool was also different from scoured wool. Scoured wool was used when an insurance company wished to know what might happen in a factory. The last investigation which he had carried out was in connection with rape oil. In the Leicester district rape oil was used extensively, and he found that pure oil was perfectly safe, in fact, almost as safe as olive oil.

Prof. J. W. COBB thought that the investigation of the connection between rise in temperatures and chemical changes carried out on oxygen absorbing substances of established composition could not fail to be of service, not only as regards those substances, but also as forming a basis for the understanding of more complicated phenomena of the same order, such as the spontaneous combustion of coal. Dr. Lloyd had expressed the opinion that the evolution of heat was often due, not to the primary oxidation, but to after-decomposition of the compounds so formed, and experimental evidence in support of that view would be interesting to consider. Mr. Winnill and his collaborators had decided that, so far as coal was concerned, it was advisable to

commence an experiment at a low temperature if a deduction was to be drawn as to the liability of the coal to spontaneous combustion. Were the same considerations not applicable in this case?

Mr. RUSHBY stated that there had been several cases of serious fires in the district caused by the spontaneous combustion of oiled wool. It would be very helpful if in such cases the insurance companies would have the oil used tested and the results published. In his opinion the presence of moisture was a chief predisposing cause. In regard to the objection to the presence of fatty acids in olive oil used in Bradford, it was not that the acids in themselves were objectionable, but that their action on the copper and iron in the combing machines formed minute quantities of salts which catalytically caused gumming of the oiled tops. He deprecated the use of resinsates by the authors as not imitating anything actually used by woolen or worsted manufacturers.

Dr. LLOYD, in reply, said that there fractive index was governed by the iodine value, and since two sources of oleic acids having approximately the same iodine value had been found to absorb oxygen at such different rates and had different properties, they did not include those readings. The oxidation of oils at the ordinary temperature took place so slowly that, although the iodine value was decreased, a rise in temperature was not observed. Most cases of spontaneous combustion in mills, etc., were probably due to initial oxidation being caused by steam leakages, radiators, or some other source of heat aided by the moisture in the wool, waste, etc. It seemed most probable that the evolution of heat was due to a number of reactions taking place at the same time, such as the absorption of oxygen, and the action of moisture upon the oxidised compounds, this being accompanied by polymerisation and also decomposition of the resulting bodies. The time required for pure oleic acid to be oxidised in air at 50° C., until maximum gain in weight was obtained, was so long that the experiments were carried out with addition of manganese resinate, the assumption being that the rate of oxidation of other acids would be in a similar ratio to that of oleic acid and oleic acid *plus* resinate. Some (distillation) oleines were much safer than oleic acid, and he thought the constitution accounted for the differences. The unsaponifiable matter increased the value of the oil as regards safety. Oleines were generally bought containing not less than 50% saponifiable; in some cases the saponifiable matter was increased by addition of cottonseed oil, which was one of the worst that could be employed. No doubt that was the cause of several cases of firing.

Communication.

GERMAN CHEMICAL INDUSTRY THIRTY YEARS AGO.

BY THIS RIGHT HON. SIR HENRY ROSCOE, F.R.S.

The following short report, written by myself for the Royal Commission on Technical Instruction, of which I was a member, was printed in 1882. This shows that even in those early years the Germans had seized upon the methods which have made their chemical industries so successful; and that money cannot secure success unless it is accompanied by perfect scientific method, and above all by the recognition of the importance of original investigation.

ON THE INFLUENCE OF TECHNICAL EDUCATION ON CERTAIN BRANCHES OF CHEMICAL INDUSTRY.

We have here collected our notes on certain special industries, viz., 1. chemical colours; 2. beet-sugar; and 3. the alkali trade, upon which the influence of technical education is plainly observable.

1.—Influence of Technical Training on the Chemical Colour Industry of Germany and Switzerland.

Among the coal-tar colour works visited by the Commissioners, were those erected on the banks of the Rhine at Basle by Messrs. Bindschedler and Busch. These works, though far less extensive than those of Messrs. Meister, Lucius, und Brüning, at Höchst, or of the Baden Aniline and Soda Works at Ludwigshafen, are carried on in a no less scientific spirit, and the general method of working adopted in all these establishments is identical.

The first principle which guides the commercial heads of all the Continental colour works, is the absolute necessity of having highly trained scientific chemists, not only at the head of the works, but at the head of every department of the works where a special manufacture is being carried on. In this respect this method of working stands in absolute contrast to that too often adopted in chemical works in this country, where the control of the processes is left in the hands of men whose only rule is that of the thumb, and whose only knowledge is that hequeathed to them by their fathers.

On entering the works of Messrs. Bindschedler and Busch one is struck, in the first place, with the adaptation of means to ends, with the substantially-built, well-lighted, well-ventilated workshops, and, above all, with the all-pervading cleanliness and neatness. But it is not of these things that we now desire to speak, but rather of the method by which their business is conducted. In the first place, then, the scientific director (Dr. Bindschedler) is a thoroughly educated chemist, cognisant of, and able to make use of the discoveries emanating from the various scientific laboratories of the world. Under him are three scientific chemists, to each of whom is entrusted one of the three main departments into which the works are divided. Each of these head chemists, who have in this instance enjoyed a thorough training in the Zürich Polytechnic, has several assistant chemists placed under him, and all these are gentlemen who have had a theoretical education in either a German University or in a Polytechnic School. An important part of the system has now to be noticed, viz., that directly under these scientific assistants come the common workmen, who have, of course, no knowledge whatever of scientific principles, and who are, in fact, simple machines, acting under the will of a superior intelligence. The many and great advantages of this arrangement are patent to all; and the fact of having men of education and refinement in positions of this kind, renders the foreign manufacturer who adopts this system less liable to annoyance and loss (from sources which we need not more nearly specify) than his English competitor, who works on a different plan.

So much for the *personnel* of the works. Now for the mode in which they carry on their work. To begin at the beginning, we find no less than ten well-equipped, airy, experimental laboratories in these works, perfectly distinct from the workshops where the manufacturing processes are carried on. In these ten laboratories, the chief departmental chemists and their assistants work out their investigations respecting the production of new colouring matters, or the more economic manufacture of old ones. To assist them in their work, a complete scientific library is at hand containing all the newest researches, for these, as

we have said, form the material out of which the colour-chemist builds up his manufacture, and no sooner do the results appear of a perhaps purely scientific research which may possibly yield practical issues, than the works-chemist seizes on them and repeats these experiments, modifying and altering them so as at last to bring them within the charmed circle of financial success.

Thanks to Dr. Bindschödl, we are able to quote a specially representative case, and a clear description of one such case is worth a host of generalities. Through the original investigations of Messrs. Emil and Otto Fischer, the attention of the manufacturer was drawn to the leuco or colourless base obtained by the action of benzaldehyde on dimethylaniline, inasmuch as they stated that the salts of these colourless bases become green on exposure to air. Founded on these observations, an endeavour was made to effect the practical manufacture of a green colouring matter by oxidation of these colourless bodies. In order to attain the desired end, the following investigations had to be made by the chemist and his assistants who were to conduct the operations:—

(1) A cheap method had to be found for manufacturing benzaldehyde.

(2) A profitable mode of making the leuco-base had to be worked out.

(3) The proper oxidising agents and their best method of application had to be determined.

(4) The best method of purifying and of crystallising the green colouring matter had to be discovered.

The laboratory experiments on the above points having proved so far successful as to give prospects of good results, operations on a somewhat larger scale were started, and these yielding a satisfactory issue, the manufacture proper of the colouring matter, now well known as malachite green, on the technical scale was commenced; all the operations being watched by, and constantly being under the control of the chemists. But even now their scientific work is by no means ended. Continuous laboratory experiments go on for the purpose of finding improvements in the mode of manufacture. Thus, for example, the improved yield, both as to quality and quantity, of the benzaldehyde is a matter of investigation. Again, the synthetic production of the pure leuco-base by a more direct process is sought for, so as to get rid of loss in working, and to obtain a yield as close as possible to that pointed out by theory. In the same way improvements in the materials used for oxidation, and in their application, are made, so as to effect the oxidation quantitatively, without the formation of by-products. Lastly, the action of various solvents is examined, so as to obtain the best form of the crystallised colouring matter. As indicating the value of these improvements made after the colour became a marketable article, it is only necessary to state that the price of the crystallised oxalate has been reduced from £2 to £1 4s. per kilo.

The foregoing may serve to give a picture of a really scientifically-conducted works, where each step in advance is made systematically, as the result of a well-devised plan of operations. This is, indeed, the only means of progress, and this fact is so well recognised in Germany that each of the much larger colour works at Höchst and Ludwigshafen possesses a staff of from 30 to 40 well paid and thoroughly trained chemists to conduct their operations.

But we are, of course, far from believing that because the methods adopted in these foreign colour works are scientific and productive of good, those made use of in all English works must therefore be unscientific and bad. Taking the whole applications of chemical science we may, no doubt, with truth say that the English industrial chemists

have been at least as successful commercially and certainly as productive in new and important discoveries, as their Continental rivals. The Germans and Swiss, however, have been and still are distinctly before us, not only in the facilities which they possess of obtaining the highest technical training in their numerous Universities and Polytechnic Schools, but what is even more to the point before us, is the general recognition of the value and importance of such training for the successful prosecution of any branch of applied science.

The following statistics give some idea of the magnitude of the colour works of Messrs. Meister, Lucius, und Brüning, at Höchst, near Frankfurt, referred to above, and founded in 1862.

The establishments occupy an area of 150 acres, of which 20 are covered with buildings. The staff includes 51 scientific chemists, 50 foremen, 15 managers and engineers, and 77 clerks and commercial men with 1,400 workpeople. The works possesses its own railways, 41 boilers, with a heating surface of 4,000 square yards, and 71 motors, either steam, water or gas engines. The workmen and officials are domiciled in houses belonging to the company, and restaurants, baths, sick clubs and pension funds have been established for the good of the employés. There is also a fire-brigade with 5 hand engines, and one steam fire-engine. The total supply of water, from 145 fire-cocks, amounts to 30,000 cubic feet per hour.

In 1882 the products of these works amounted to:—

- (1) 6,600,000 lb. weight of alizarin.
- (2) 2,200,000 lb. weight of aniline oil.
- (3) 1,540,000 lb. weight of aniline, resorcin, and naphthol.

Colours.

The following are the separate products classed together under the last head:—

Aniline and aniline salts.
Fuchsine (no arsenic used in its preparation).
Methyl violet.
Green and blue colours.
Eosin colours.
Naphthol colours.
Alizarin and artificial indigo.
Quinolin derivative (kairin a new substitute for quinine).

Acids.

The most important raw materials employed in manufacturing the foregoing products are as follows:—

40,000	tons coal.
3,000	" tar products.
2,400	" caustic soda.
400	" potash salts.
2,900	" carbonate of soda.
17,400	" sulphuric acid.
10,100	" various other acids.
1,500	" iron borings and filings.
250	" wood spirit and spirits of wine.
1,000	" various chemicals.
6,800	" common salt.
2,050	" carbonate of lime.

The whole of the sulphuric, hydrochloric, and nitric acids used, is made on the works.

From about 70 to 80% of all the aniline colours manufactured are exported, the remainder used in Germany.

About 90% of the total make of alizarin is exported chiefly to England, but considerable quantities find their way to America, Russia, France, Holland, Spain, and Italy.

One of the most recent and most interesting additions to the above list of products is a derivative of quinolin, termed kairin, lately discovered by Emil Fischer. This substance, which is now being made at Höchst at the rate of about 22 lb.

daily, has been shown to possess important febrifuge properties, even exceeding quinine in activity, and it is not impossible that this artificial product obtained from coal-tar may be the means of supplanting altogether the natural alkaloid. The importance of this discovery, should it serve the above purpose, can of course hardly be overrated, and it will then add another and most striking example to the numerous ones which already exist of the immense importance to the human race of researches in purely scientific organic chemistry, which at one time appeared to have no practical value or possible application. It may, therefore, serve again to point the moral, which cannot be too strongly insisted upon, that it is only by the highest and most elaborate achievements of pure scientific investigation that the greatest practical advantages to mankind can be secured.

II.—Influence of Technical Training on the Beet-sugar Manufacture.

Probably no more striking illustration of the rise of a successful and most important industry depending upon the application of the scientific principles of engineering and chemistry can be found than in the Continental beetroot sugar manufacture. The increase in the consumption of sugar in this country has been very great. In 1843 it amounted to 200,000 tons; this figure was doubled in 1854; in 1874 it reached 850,000 tons, and in 1882 1,000,000 tons of sugar were consumed in the United Kingdom. Of these quantities in 1870, 165,000 tons consisted of beetroot sugar, whilst in 1882 the total was over 400,000 tons valued at £10,000,000. The whole of this amount is imported from Belgium, France, and Germany, as no beetroot sugar is manufactured in this country.

To show the extent and growth of the Continental industry in a small country, we may cite the case of Belgium, with a population of 5,600,000. In 1846 the area under cultivation for beetroot was only 5,421 acres; in 1866 this was increased to 44,480 acres, and in 1882 to 86,490 acres. The quantities of raw beet-sugar manufactured in Belgium were in 1880–81, 68,000 tons; in 1881–82, 73,000; and in 1883 probably 80,000 tons were manufactured in 156 works; that is, about one ton of sugar is obtained from one acre of beetroot crop. In France and Germany the area of beet crop and the consequent production of sugar is very much larger. The processes of extraction and purification of sugar from beet are complicated and delicate, requiring both scientific knowledge and capital, as the plant necessary for working up the juice into refined sugar is of a very costly character, and the operations require careful and scientific handling in order to ensure success. The juice contains not only sugar crystallisable and uncrystallisable, but also a considerable quantity of inorganic salts and organic substances other than sugar, and the presence of these latter ingredients prevents a large portion of the sugar from crystallising, and therefore they must be removed. This removal of the injurious constituents can only be effected when an exact analysis of the juice and of the sugar has been made, and this must be done at each stage of the operation, so that the mode of working shall be properly regulated, and such an investigation is a somewhat complicated process, needing skilled chemical knowledge. The quantity of sugar which is rendered uncrystallisable by the presence of inorganic salts or ash is about five times the weight of the ash.

In order to obtain the sugar which would otherwise be thus lost, many processes have been adopted, and of these that involving the strontia is the most recent. This method was secretly worked for some years in certain works in Germany, but it has now been generally adopted under

the patent of Dr. Scheibler, chemist to the Beetroot Sugar Institution. By the use of the strontia process large profits have been made, and the plan has been successfully introduced into France and Belgium. The Continental beetroot sugar manufacture, partly of course in consequence of the Government bounties, has been a very profitable one, annual dividends as high as 100% having been paid by some sugar-mills. It would seem, however, that owing to the great increase in the number of these establishments the trade has seen its best days.

The question of the cultivation of sugar beet in the United Kingdom, and especially in Ireland, though it has received a certain amount of attention in various quarters, has not come to any practical issue. About 1850 Lord Clarendon, then the Lord Lieutenant of Ireland, ordered an official inquiry on the subject of the growth of beetroot in that country, and the results of that inquiry, presented to Parliament in 1852, showed that 78% of beets grown in Ireland were rich enough in sugar to be worked, whilst the corresponding amounts for England and Belgium were 75% and 70% respectively. At that time the West India sugar had the command of the market; the sugar trade has, however, since that date been revolutionised, but no step has yet been taken by agriculturists and capitalists to commence the growth of sugar beet and the manufacture of beet sugar in this country. To produce the 400,000 tons of beet sugar now imported from the Continent we should need as many acres, but as the beet crop is taken only every three years the total acreage required would be 1,200,000. A large proportion of this, if not the whole of it, could be found in Ireland, and there can be no doubt that the introduction of such an industry would do much to improve the general agriculture of that country.*

III.—Influence of Technical Training on the Alkali Manufacture.

The beneficial action of high scientific and technical training upon the chemical colour and beet sugar industries having thus been shown, it becomes of interest to examine the effects of such education on another no less important branch of chemical manufacture, viz., the alkali trade, and in this instance the comparison of the relative position of the Continental and English works is by no means in favour of the former. In the first place, as regards the workmen themselves, it may be truly said that in no country does any real amount of scientific education reach the ordinary workman in alkali works, who are rather labourers than artisans. Moreover, the foremen, both in this country and abroad, are almost invariably men who entered the works either as laboratory boys or as ordinary workmen, and who have risen by virtue of industry and native intelligence, but who have had no scientific training beyond that afforded by the occupation in which they have been engaged. So far, therefore, as the education of the workmen employed in alkali works is concerned, the foreigner has no advantage over us, nor have we any over the foreigner. In the case of the managers and proprietors the matter is, of course, different. On the Continent nearly every manager of a soda works is a man of a very high degree of scientific attainment, a highly trained engineer, and a highly trained chemist. An English manager, one at least of the older school, on the other hand, is scarcely ever a man who has had a similar training to that of Continental managers before they enter upon the duties of

* The sugar factory of Mr. Duncan, established some years ago at Lavenham, and which was not successful, is about to be reopened. The use of strontia and other improvements in the manufacture, together with lower railway charges on the roots, encourage the new proprietors to anticipate better results.

management. The Continental alkali makers are men of wider knowledge and of more extended scientific attainments than their English brethren. Thus, whilst probably none of our English alkali makers could discuss the chemistry of the latest organic colouring matter, nearly all the Continental masters are able to do so. But in the opinion of those best qualified to judge, and speaking of course of the managers of the first-class works in each case, there is no doubt that the English alkali makers are just as well acquainted with the scientific bearings and relations of their own manufacture as their Continental rivals. Nor is the foreigner a better alkali maker than the Englishman, for even in cases in which the former obtains better results than are usual in this country, as regards economy of fuel and raw material, the cause is to be sought rather in the fact that his cheaper labour permits him, and his dearer fuel and raw material compels him, to do what dear labour and cheap fuel and material absolutely forbid to the English alkali maker, than in any superiority in scientific training of the one over the other. It certainly cannot be said that the English soda industry suffers, in comparison with that of the Continent, owing to the want of scientific knowledge on the part of those who conduct it. Men of the highest talent and most eminent for their scientific knowledge are found in all our large alkali works, and it is a remarkable fact that with one or two exceptions everything in the way of

important improvements in the alkali manufacture by the Leblanc process has originated in England. Hydrochloric acid condensing towers, revolving black-ash furnaces, Glover-towers, mechanical calcining furnaces, mechanical salt-cake furnaces, plus-press furnaces, and last, but not least, the Weldon plant; each one of these English improvements marks an era in the alkali manufacture, and has been at once adopted as a necessity by all manufacturers. Even the well-known ammonia soda process, first successfully worked in Belgium, is chemically an English invention (Dyer and Hemming), though made industrial by a Belgian (Solvay). No less remarkable is it that, certainly often in England, and in some cases abroad, those men who have made the most important improvements or discoveries in the alkali manufacture have been self-taught, proving the truth of the axiom that a scientific education cannot stand in place of natural sagacity and workshop training.

It is the opinion of those intimately acquainted with the present condition and future prospects of the alkali trade, both at home and abroad, that such differences as exist between the results obtained on the Continent and at home are due to differences of national character and local circumstances rather than to a superiority of scientific education, and it may be questioned whether many Continental alkali works could survive in face of English competition, if the import duties by which they are at present protected were abolished.

Journal and Patent Literature.

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I.—GENERAL PLANT; MACHINERY.

PATENTS.

Refrigerating; Processes for. W. R. Ormandy, Warrington, J. Walker, Mirfield, and F. Holroyd, Elland. Eng. Pat. 27,985, Dec. 5, 1913.

A SATURATED or supersaturated solution of calcium chloride or other alkaline-earth halide is used to absorb the ammonia in a refrigerating apparatus. (See also Eng. Pat. 25,806 of 1907; this J., 1908, 740.)—W. H. C.

Distillation of liquids. O. Söderlund, T. Boberg and Techno-Chemical Laboratories, Ltd., London. Eng. Pat. 28,537, Dec. 10, 1913.

THE apparatus is of the type in which the vapour given off is slightly compressed and used as a heating medium in the evaporator (see Eng. Pat. 12,462 and 22,670 of 1911; this J., 1911, 971; 1912, 183). To prevent rise of boiling point of the solution undergoing evaporation, due to concentration, and also to prevent formation of scale, only a small proportion of the liquid is evaporated and the heat contained in the concentrate as well as that in the condensed liquid is recovered. A pair of evaporators or a single evaporator divided into compartments is used, with a pair of recuperators. Part of the feed solution is heated in one of the recuperators by the condensed liquid and the remainder is heated in the other recuperator by the concentrate.

—W. H. C.

Solids suspended in gases; Apparatus for collecting. W. E. Playter, Collinsville, Ill. U.S. Pat. 1,118,045, Nov. 24, 1914. Date of appl. Feb. 19, 1914.

THE gas is forced through bags of pervious material suspended within a chamber. From time to time the current of gas is shut off, and compressed air is forced into flexible pipes suspended within the bags, causing these to oscillate, strike the bags and shake down the dust.—W. H. C.

Suspended matter; Means for removing particles of from bodies of gas or fluid. W. W. Strong, Pittsburgh, and A. F. Nesbit, Wilkesburg, Assignors to R. B. Melton, Pittsburgh, Pa. U.S. Pat. 1,119,469, Dec. 1, 1914. Date of appl. Feb. 11, 1913.

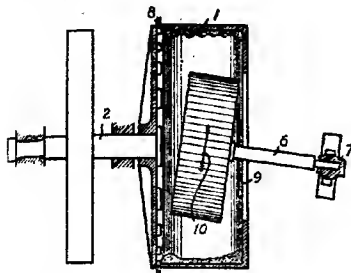
THE gas is passed through a series of cells formed by enlargements in a conduit which acts as an earthed electrode. Active electrodes are suspended within the conduit and a wide difference of potential is maintained between the electrodes.

—W. H. C.

Grinding, or crushing machine. J. S. Fasting, Frederiksberg, Denmark. Eng. Pat. 14,784, June 19, 1914. Under Int. Conv., June 19, 1913.

THE material is fed through the opening, 9, into the drum, 1, which is carried on, and rotated by, the shaft, 2. A grinding member, 10, supported from the bracket, 7, by the shaft, 6, which is inclined to, but does not intersect, the shaft, 2, is rotated within the drum and is capable of a

limited lateral movement. The material is ground between the grinding member and the drum and



is pushed forward and discharged through the openings, 8.—W. H. C.

Desiccating machine. L. P. Mick, Chicago, Ill. U.S. Pat. 1,118,304, Nov. 24, 1914. Date of appl., Nov. 1, 1913.

THE material is sprayed into a rotating horizontal cylinder, and the deposited powder is removed by a vacuum device fixed within the cylinder and almost touching it at its lowest part.—W. H. C.

Drying-kiln [for wood]. E. A. Hallam, Portland, Oreg. U.S. Pat. 1,119,595, Dec. 1, 1914. Date of appl., Feb. 25, 1914.

JETS of steam are delivered downwards from pipes fixed in "walk-ways" at the sides of the stack of timber in the drying kiln. The steam mixed with air passes down through skeleton floors at the base of the "walk-ways" to a heater and then rises through the stack of timber.

—W. H. C.

Drying apparatus. F. Zorn, Fienstedt, Germany. U.S. Pat. 1,120,879, Dec. 15, 1914. Date of appl., May 19, 1913.

VERTICAL cylinders mounted in a brickwork heating chamber, so that they can be revolved, are divided into compartments by transverse steam heating plates and sieve plates. Each cylinder is provided with a hollow vertical shaft and with flame tubes. The steam plates are heated by steam introduced through the hollow shaft. The material is fed into the upper ends of the cylinders by screw conveyors from a common feed trough, and its descent is facilitated by rakes moving over the upper surface of the sieve plates. Adherence of the material to the flame tubes is prevented by brushes.—W. H. C.

Filtrating medium. J. E. Porter, Syracuse, N.Y., Assignor to General Filtration Co., Inc., Rochester, N.Y. U.S. Pat. 1,118,441, Nov. 24, 1914. Date of appl., April 9, 1914.

A RAPID filtering medium having strata of different densities, the stratum of one density being formed solely of a quantity of sand mixed with a very small proportion of infusorial earth and fused together with less than half the quantity of powdered glass.—W. H. C.

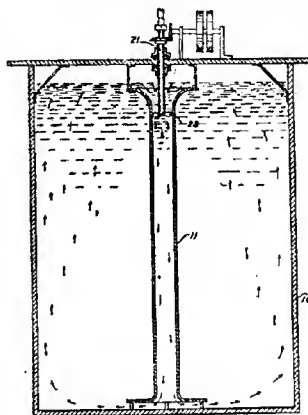
Filter-press and filtering apparatus. O. J. Salisbury, Salt Lake City, Utah. U.S. Pats. (A) 1,120,628 and (B) 1,120,629, Dec. 8, 1914. Dates of appl., Sept. 30 and Jan. 2, 1914; (B) renewed Nov. 2, 1914.

THE filtering elements are enclosed in a casing which consists of: (A) a horizontal cylindrical

shell, split longitudinally and hinged at the top so that each half can be removed simultaneously; of (B) a rectangular casing, the opposite sides of which can be removed.—W. H. C.

Mixing device. G. Crerar, Spokane, Wash. U.S. Pat. 1,119,405, Dec. 1, 1914. Date of appl., April 8, 1913.

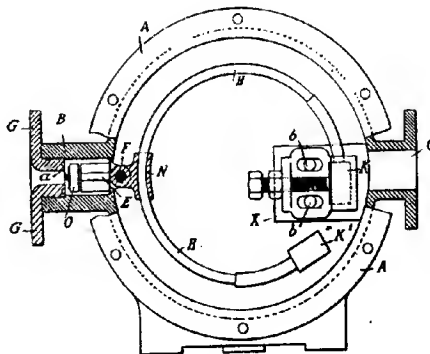
A FLANGED cylinder, 11, is fixed centrally within a tank, 10. A short shaft, 21, driven by gearing



from above, projects into the upper part of the cylinder, and carries at its lower end a propeller, 23, which sets up a circulation in the direction indicated by the arrows.—W. H. C.

Hydro-extractor [steam trap]; Automatic — which allows water to pass but retains the useful steam. V. A. Prost. Fr. Pat. 469,381, March 7, 1914.

A TUBE, H, of flattened oval section, filled with petroleum spirit and having one end, K', free, is



fixed by the other end, K, to the block, X, within the casing, A, provided with an inlet, B, and an outlet, C. The tube, H, carries a rider, N, which is attached by the pin, F, and the winged rod, E, to the valve, O. The apparatus is connected by the flange, G, with the steam apparatus. So long as water only passes through the orifice, a, the tube, H, retains its shape, but as soon as steam enters, the liquid in the tube, H, expands,

whereupon the tube acts as a spring and presses the valve, O, on to the seat, a, thus shutting off the escape of steam. The lift of the valve is regulated by the adjusting screws, b, b.—W. H. C.

Heating, evaporating, volatilising, or distilling liquids by electricity; Apparatus for—T. McClelland, jun., Cathcart, Scotland. U.S. Pat., 1,121,743, Dec. 22, 1914. Date of appl., Nov. 30, 1912.

SEE Eng. Pat. 27,422 of 1911; this J., 1912, 1112.

Producer gas and [steam] power plant. Eng. Pat. 27,922. See IIA.

IIA.—FUEL; GAS; MINERAL OILS AND WAXES.

Corrosion of refractories by salts in coal. A. B. Searle. J. Gas Lighting, 1914, 128, 535—536.

THE speed of reaction between the salts in coal or coke and the fireclay or silica of retorts or bricks has been found to depend more on the physical state of the refractory material than on chemical differences, it being possible to control the fusibility by mixing fine and coarse material, so that either a silica mixture or clay mixture will melt the more easily. Corrosion is least marked when the retort material has a close surface or, in a porous material, when the grains are coarse and hard-fired. If the retorts be made of clay, a large proportion of it should have been burned and made into coarse "grog" before being mixed with the remainder. Water in the retort acts injuriously by causing intimate contact between the retort and the salts, and by facilitating reaction. The introduction of wet materials into the retort should therefore be abandoned, or, if this be impossible, a basic retort material (preferably sintered magnesite brick) should be employed, or the retort lined with chromite or graphite wash.—F. SODN.

Coke-oven gas; Supply of—for town lighting in Middlesbrough. J. Gas Lighting, 1914, 128, 726.

COKE-OVEN gas is supplied for town lighting in Middlesbrough from the Newport Iron Works. A suitable quality of gas is obtained by providing a separate main for the "rich" gas produced in the early stages of carbonisation, the "lean" gas obtained later being used for heating the ovens (cf. Douglas, this J., 1912, 762). A battery of 46 regenerative ovens supplies up to 1,600,000 cub. ft. per day. A separate by-product plant of the direct recovery type is used for each of the two mains. The gas is cooled to its dew-point in air-coolers, treated with tar-sprays to remove tar, and passed into saturators to recover the ammonia as sulphate. The gas leaving the saturators, is freed from water in surface coolers and cooled to normal temperature by spray coolers. Naphthalene is recovered from the effluent water. The "rich" gas at 8–10 inches water pressure then passes through a rotary washer fed with benzolised creosote oil to remove any remaining naphthalene, to the gas works for distribution. The "lean" gas is kept at a lower pressure and any excess of "rich" gas not required by the town is mixed with it. Benzol is recovered from the mixed gases, but that in the "rich" gas is retained for illuminating purposes. The gas supplied averages 600 B.Th.U. net, slight variations occurring when the gas from a newly charged oven is introduced.—W. F. F.

Gas leaks; Effects of—on bituminous pavements. G. C. Warren. Amer. Soc. Municipal Improvements. J. Gas Lighting, 1914, 128, 740.

COAL gas was passed through two tubes, one containing sand, and the other a sand-asphaltum mixture. The gas from the latter gave a flame of considerably diminished luminosity as compared with that from the former. Liquid asphaltum through which coal gas was passed for twelve days gained 2.98% in weight and 4% in volume, and its viscosity was considerably diminished. Coal gas will attack any form of bituminous pavement, sometimes at a considerable distance from the leak, due to penetration through stratified material. The "plugging" test for gas leaks is not reliable.—W. F. F.

PATENTS.

Coal briquettes; Manufacture of—H. J. Phillips, London, and A. Phillips, Tredegar, Mon. Eng. Pat. 29,009, Dec. 16, 1913.

100 PARTS of coal are ground to a pulp with 45 to 60 parts of water and the mixture is subjected to a pressure of 3 to 5 tons per sq. in. in a mould having oppositely acting plungers to eliminate the greater part of the moisture. The partly formed briquettes are passed through a tunnel chamber heated to 80° C. at the inlet and 250° to 500° C. at the outlet, and are then again subjected to a pressure of from 5 to 15 tons per sq. in. in another press.—W. H. C.

Fuel briquettes; Manufacture of—J. B. Cann, Boston, Mass. U.S. Pat. 1,121,325, Dec. 15, 1914. Date of appl., Jan. 13, 1913.

SMALL particles of fuel are mixed with a binder which is then rendered adhesive by treatment with steam saturated with an oleaginous substance. The mixture is then pressed into briquettes which are subsequently heated.—W. H. C.

Coke-ovens. L. L. Summers, Chicago. Eng. Pat. 10,284, Apr. 25, 1914.

IN ovens of the type described in Eng. Pats. 6504 and 7049 of 1910 (this J., 1911, 274, 202), the horizontal retort is divided into sections by light longitudinal walls, these and the retort side walls and roof being provided with longitudinal heating ducts. Each section has a reciprocating floor, on which the carbonaceous material is fed at one end, the coke being discharged at the other. All the floors are connected to a common cross-head and reciprocated in unison by a single hydraulic ram. The restraining action of the wall of the charging hopper upon the layer of material when it is reciprocated, causes uniform compression in all the retort sections. Each of the heating ducts in the walls and roof is formed with more than one tile section to avoid cracking due to unequal expansion.—W. F. F.

Coke-ovens; Recuperators for retort—C. H. Hughes, Syracuse, N.Y., Assignor to Semet-Solvay Co., Solvay, N.Y. U.S. Pats. (A) 1,120,146 and (B) 1,120,147, Dec. 8, 1914. Dates of appl., June 19, 1912, and Jan. 7, 1910. (B) renewed Sept. 14, 1912.

(A) THE air supply is preheated by hot waste gas passing between two horizontal plates connected by tubes through which the air passes. (B) The gas passes in series through the two spaces formed between three horizontal plates, the air heating tubes passing across both spaces. In each case expansion of the tubes is provided for.—W. F. F.

Coke-ovens or gas-retorts; Heating of—H. W. Woodall, Poole, Dorset. Eng. Pat. 3363, Feb. 9, 1914.

THE oven or retort gas is mixed with waste flue gases to make it suitable for use with burners and flues constructed for heating by producer gas.—W. F. F.

Gas-retorts; Charging and discharging apparatus for—F. J. Bancroft and J. B. Hansford, New Barnet, Herts. Eng. Pat. 13,218, May 29, 1914.

A TROUGH, similar in shape to the retort and having a plate lying along the bottom and a charging head at the outer end, is filled with fuel, and the plate and head are moved forward with the fuel into the retort, after which the plate is withdrawn and then the head. To discharge the retort the head is fixed at the forward end of the plate and the two are pushed bodily into the retort.—W. F. F.

Producer-gas and [steam] power plant. A. H. Lynn, Westminster. Eng. Pat. 27,922, Dec. 4, 1913.

STEAM is withdrawn from the engine or turbine at a point where its pressure is about 30 lb. abs., and used for driving the blowers and other auxiliary machinery, being then exhausted into the gas producers.—W. F. F.

Gas-generator. J. C. Walton, Fort Worth, Tex., Assignor to J. A. Wisherd, Stanton, Nebr. U.S. Pat. 1,118,319, Nov. 24, 1914. Date of appl., May 1, 1913.

THE generator, containing metal scraps, is provided at the bottom with perforated pipes open to the atmosphere at both ends for the supply of air, and means for drawing in air automatically and intermittently. Acid and oil, contained in separate tanks, are forced by pneumatic pressure into a mixing pipe which communicates with a perforated pipe in the upper part of the generator tank, and a baffle is provided whereby the acid and oil are distributed throughout the tank. A service pipe, provided with a back-check, is connected with other perforated pipes which extend from the upper part of the tank to the exterior.—W. C. H.

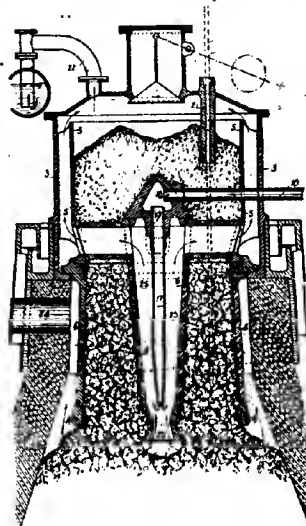
Gas; Process and apparatus for making—H. Burgi, Springfield, Mass. U.S. Pat. 1,120,273, Dec. 8, 1914. Date of appl., May 13, 1912.

COAL is fed continuously downwards through a heated vertical retort, the coke being withdrawn at the bottom. Suitable enriching hydrocarbons are supplied through a jacketed pipe extending downwards inside the retort to a zone where a "cracking" temperature prevails, and the resulting gas mixes with the coal gas, and is withdrawn from the top of the retort.—W. F. F.

Gas producers; Retort for distilling, at very high temperatures, the fuel to be supplied to—H. Mastaing and L. Monnier. Fr. Pat. 469,967, March 23, 1914. Under Int. Conv., Jan. 10, 1914.

THE retort, which serves also as a feed-hopper for the gas producer, consists of four separate, easily replaceable parts, 3, 4, 5, 6. The producer, 7, is charged with coke and set in operation, the gas being exhausted through 24 and 22, or through 22 alone. To attain the high temperature (1000°–1300° C.) necessary for the complete coking of the raw fuel fed into the chamber, 5, a portion of the producer gas is burnt in the chamber, 25, by air introduced under pressure through the pipes, 16,

17. The coked fuel falls readily from the chamber, 4, into the producer, but if necessary a poker may be introduced through the opening, 21. The gas



drawn off through the pipe, 22, is a mixture of coal gas and producer gas with a calorific value about double that of ordinary producer gas.—A. S.

Tar or other liquids; Centrifugal apparatus for separating— from gases. Soc. Générale de Matériel & Gaz. Fr. Pat. 460,802, Feb. 20, 1914. Under Int. Conv., Feb. 28, 1913.

A SEPARATOR for removing tar, oil, or other suspended matter from gases, consists of a horizontal cylinder divided into two compartments by a transverse partition having an opening at its centre. The gas is introduced tangentially through an inlet at the periphery of one compartment, travels with increasing velocity to the centre, and passes through the opening into the other compartment, wherein its velocity decreases from the centre to a tangential outlet at the periphery. Two or more of such cylinders may be used in series. Each compartment is provided with a drain pipe for discharging the separated tar or the like.—W. F. B.

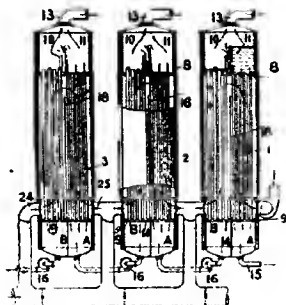
Oils; Process for cracking—O. H. Valpy and O. D. Lucas, London. Eng. Pats. 20,470, Sept. 10, 1913, and 2838, Feb. 3, 1914.

STEAM superheated to a temperature slightly below the cracking point is sprayed into the oil in a still, and the mixture of oil vapour and steam is passed through heated catalysing tubes of nickel, which may be packed with catalysing material, and thence to a coil in the oil still where the heat of the cracked vapour is utilised for heating the oil. The catalysing tubes may be heated electrically, or by an oil burner.—W. F. F.

[Oil] *Distilling apparatus*. R. C. Dundas, Los Angeles, Cal. U.S. Pat. 1,120,030, Dec. 8, 1914. Date of appl., Jan. 23, 1913.

THE liquid is pumped through a series of vessels, 1, 2, 3, each consisting of a vertical cylinder divided into three superposed chambers by the tube-plates, 8, 9. The lowest chamber is divided

into two compartments, A, and B, by the vertical partition, 14, the middle chamber by the vertical partition, 18, into two compartments communicating at the top, and the upper chamber into two



communicating compartments by the partition, 10, the compartment, 11, on the right serving as a reservoir. The top and bottom chambers are connected by means of tubes expanded into the tube-plates, the tubes on the left of the partition, 18, being of larger diameter than those on the right. The oil enters through the pipe, 15, into the compartment, A, of the cylinder, 1, rises through the smaller tubes into the reservoir, 11, overflows and passes down the larger tubes into B, and is withdrawn by the pump, 16, and forced into the second cylinder, and so on. The heating medium enters the last cylinder, 3, by the pipe, 24, passes upwards round the larger tubes and downwards round the smaller tubes to the exit, 25, and so on through the series. The vapour given off escapes through the pipes, 13.—W. H. C.

Oils and the like: Adhesive test for —. C. B. Osborne, Sacramento, Cal. U.S. Pat. 1,120,624, Dec. 8, 1914. Date of appl., March 12, 1913.

A FILM of the oil is interposed between a hollow stationary cylinder and a loosely fitting ring surrounding it, a heating or cooling agent is circulated through the cylinder, and the ring is rotated by means of a weight and cord.—W. H. C.

Gasolene; Process of and apparatus for recovering and grading —. R. D. Bassett, Kinzua, Pa., Assignor to K. A. Krantz, Kinzua, and H. H. Bassett, Grand Valley, Pa. U.S. Pats. (A) 1,120,669 and (B) 1,120,670, Dec. 15, 1914. Dates of appl., March 14, 1914 and April 30, 1912.

(A) HEAVY low-grade gasolene is added to liquid high-grade gasolene, or gas rich in gasolene, under pressure, and the mixture cooled. (B) The apparatus consists of two long casings having chambers at the ends connected by pipes, the middle portions of the casings forming jackets for the pipes. A mixture of low-grade gasolene and liquid and gasified high-grade gasolene is forced through the two sets of pipes in series, and the liquid portion finally separated from the lean gas. This gas at high pressure and temperature is passed through the jacket of the first set of pipes, and then through a reducing valve at a greatly reduced pressure and temperature to the second jacket.—W. F. F.

Manufacture of carburetted [methyl] alcohol. Fr. Pat. 469,903. See IIa.

Utilisation of gas producers for the manufacture of ammonia by synthesis. Fr. Pat. 469,331. See VII.

[Electrical] purification of combustible gases. U.S. Pat. 1,120,475. See XI.

Gas analysis apparatus. U.S. Pat. 1,121,244. See XXIII.

IIb.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Flame standards in photometry. E. B. Rosa and E. C. Crittenden. Bull. Bureau of Standards (U.S.A.), 1914, 10, 557—595.

As a result of a large amount of experimental work it is concluded that the Harcourt pentane lamp is the most practical flame standard available, but that, as made at present, it cannot be considered as a reproducible primary standard, being decidedly inferior to the Hefner lamp in this respect. For use as a primary standard one or more lamps should be constructed to very exact specifications, and operated within very narrow limits of temperature and humidity, with much more rigorous requirements as to the density and boiling point of the pentane, and in an atmosphere of constant oxygen content. In a very large number of tests with the present standard type of pentane lamp, the correction to be applied for water vapour (percentage decrease of candle-power caused by an increase of 1 litre of water vapour per cb. metre of air) as determined at the Bureau of Standards was found to be 0.567, a value appreciably lower than that found in the National Physical Laboratory (Paterson, this J., 1908, 553) and by Butterfield, Haldane, and Trotter (this J., 1911, 1005). The equations given for the Hefner and pentane lamps respectively are:

$$I = I_n[1 + 0.0055(8.8 - h) - 0.00011(760 - b)]; \text{ and}$$

$$I = I_n[1 + 0.0057(8.0 - h) - 0.0008(760 - b)],$$

where I is the observed candle-power; I_n is the normal value of the lamp at an atmospheric humidity of 8.8, or of 8 litres of water vapour per cb. metre of air, and a barometric pressure of 760 mm. of mercury; h is the actual humidity as found by the Assmann psychrometer, and b is the barometric pressure.—A. S.

PATENT.

[Methyl] alcohol; Manufacture of carburetted —. C. Henry. Fr. Pat. 469,903, June 2, 1913.

THE oily and aqueous liquors obtained by the destructive distillation of peat, are distilled together in an apparatus furnished with an agitator, the products (methyl alcohol, acetone, light hydrocarbons, water, and acetic acid) passing over below 90° C. being collected. The distillate is treated with quicklime to remove water and acetic acid, and the products of b. pt. below 65° C. are separated by rectification, leaving carburetted methyl alcohol suitable for use as a motor fuel.—A. S.

III.—TAR AND TAR PRODUCTS.

Nitro-groups; Influence of — on the reactivity of substituents in the benzene nucleus. J. Kenner. Chem. Soc. Trans., 1914, 105, 2717—2738.

A META-DIRECTIVE grouping, especially the nitro-group, confers a certain degree of mobility on substituents in ortho- or para-positions, and in some cases ortho-para-directive substituents, notably chlorine, produce a corresponding effect on meta-substituents. An explanation is offered in terms of Flürscheim's views, namely, that the

attachment of the substituent is loosened. The mobile substituent can take part in reactions, be displaced by other groups, etc., in spite of the steric influences to which it is exposed, and the phenomenon is correlated with the property of nitro- and other meta-directive groups of forming additive compounds. In connection with the above views, the action of hydrazine on methyl 2-chloro-3,5-dinitrobenzoate was shown to yield directly 5,7-dinitro-3-keto-1,3-dihydroindazole. The nitro-groups of this compound were displaced by chlorine atoms when it was treated with phosphoryl chloride at 180° C.—G. F. M.

Acetyl-nitro-substitution. Substitution in aromatic hydroxy-compounds. Part II. V. J. Harding. Chem. Soc. Trans., 1914, 105, 2790—2800.

IN the presence of methoxyl groups the acetyl group substituted in certain positions in the benzene nucleus can be directly displaced by the nitro-group. Thus 3,4-dimethoxyacetophenone yields 1,6-dinitro-3,4-dimethoxybenzene, and 3,4,5-trimethoxyacetophenone is converted into 3,4,5-trimethoxynitrobenzene. On the other hand, if the acetyl group occupies a position which, in the phenol ether, is inactive to nitric acid a nitro-ketone is produced, 2,3,4-trimethoxyacetophenone, giving, for example, 6-nitro-2,3,4-trimethoxyacetophenone.—G. F. M.

IV.—COLOURING MATTERS AND DYES.

Manufacture of aniline dyestuffs in Great Britain.

THE Government scheme for the establishment of a national dyestuff industry (see this J., 1914, 1199, 1200; 1915, 22) has not, up to the present, received the enthusiastic support of those most interested. A meeting of the Consultative Committee was held at the Board of Trade on January 13th to consider the position, but it adjourned for a week without making a report. After the meeting on Jan. 20th it was announced that Mr. L. B. Lee (Calico Printers' Assoc.) and Mr. M. S. Sharp (Bradford Dyers' Assoc.) had withdrawn from the Committee in view of the attitude of their respective companies. The Committee will be enlarged and will proceed immediately to prepare a scheme on a modified financial scale, which, while not departing from the general lines originally laid down, will be more advantageous to the subscribers of the proposed company.

The fact that adequate support has not been forthcoming is hardly surprising, in view of the diversity of opinion on the subject and the large number of objections that have been urged against the scheme, both as a whole and on points of detail. Under the circumstances, a résumé of some of the points raised may be of interest.

In October last, the Leeds Chamber of Commerce suggested to the Government Committee (which was appointed in August to consider the question) that their action should take the form of protection by means of import duties on the products in question, either without limitation of time or for such a period as would encourage the investment by traders of the necessary capital, and they further called attention to the need of duty-free alcohol.

The Derby Chamber made the following recommendations: That the Government be requested to take steps to encourage the manufacture of aniline dyes in the country; that private enterprise is to be preferred to a Government undertaking; that it is very necessary that a supply of duty-free alcohol for the manufacture of chemicals should be permitted. Small undertakings to manufacture quite a limited number of

colours at first will be more successful than one large concern, and the movement will be considerably assisted by a combination between gas works, tar distillers, alkali works, etc., for the purpose of advancing their crude products a further stage.

The Manchester Chamber passed a resolution declaring that they were unable to support the Government scheme, but later this resolution was rescinded. On December 5th, the Leeds Chamber passed a resolution expressing the opinion that the proposed scheme would not meet the difficulties of the situation, but would stifle competition and establish a monopoly. The Chamber repeated its demand for a substantial import duty on coal-tar colours to be imposed for some years after the close of war.

The Executive Council of the Association of Chambers of Commerce passed a resolution in terms similar to that of the Leeds Chamber of Dec. 5th, and the Council of the London Chamber of Commerce on Jan. 14th passed a resolution declaring that adequate tariff protection should be guaranteed for at least ten years after the end of the war, but such protection should be considered as a means of meeting a national emergency, and in no way as a precedent for future action on the same lines. The Board of Directors of the Manchester Chamber of Commerce, however, dissociate themselves entirely from the policy of even temporary protective duties on dyestuffs, but consider that, in the exceptional circumstances, some adequate measure of financial assistance from the State is warranted.

Among the objections raised in other quarters to the scheme, there has been the feeling that the Government was not doing enough to help the industry. It has been suggested that a better course would have been for the Government to find the whole of the capital or to guarantee the interest to those who did so; alternatively the Government might have taken the same risks on ordinary shares that the shareholders were asked to take, instead of securing their capital on debentures. Again, many people hesitated to bind themselves under the contracting clause, which compelled them to buy only from the new company, owing to their doubt as to its ability to produce dyes of the requisite quality at a suitable price.

In a letter to the "Morning Post" on January 7th, Mr. C. Diamond, a member of the committee of textile manufacturers appointed to confer with the Board of Trade on the subject (see this J., 1914, 1200), has enumerated and answered some of the other objections that have been raised; the following are extracts from this letter:—

"Conservative estimates go to show that in order to produce two million pounds' worth of dyes per annum the capital proposed is ample to purchase existing concerns, to erect new works, and to leave perhaps 2½ million pounds or more for working capital or as a fighting fund. The German capitalisations and output bear out these estimates. The money put in, if wisely used, will be ample to build up a great British industry, and if at the end of ten years it has been found that it was necessary to expend £250,000 a year for this purpose, there should be then an earning power and a goodwill in the company equal to the outlay.

"The Government has been forced by the pressure of the trades to endeavour to organise this great national effort. If those concerned will do it themselves no doubt the Government will be glad to stand aside. There is, however, no evidence of this. Hence the Government offer of £1,500,000 as a loan, at low interest, for twenty-five years, the interest and sinking fund being payable only out of earnings. The Government requires that those whose vital interests are involved should do

their share in the matter. On an annual trade of £200,000,000 the £3,000,000 to be raised is only 1½%. The first amounts called up are very small. The remaining amounts are also in very small instalments at very long dates.

"To do nothing, to wait till the war is over, and then go back to Germany for our dyes, and to confess failure and helplessness, would be shameful. But more, it would mean that later the Germans could and would charge such prices for their dyes as would soon eat up all the capital proposed to be raised for this scheme, and still leave British industries in a state of dependence. The monopoly of the synthetic dye industry by Germany compels us to believe that there are those amongst us who are willing to accept such a conclusion.

"The Germans can, if they like, when the war is over, offer their dyes for nothing, but under the co-operative scheme now proposed their competition cannot touch the proposed concern or injure the new industry. If the users and the allied trades resolve that never again shall they be placed in such jeopardy, the Germans will be powerless and the British company unassailable.

"The very biggest users of dyes are on the Committee, and agreed to support the Government scheme in principle. Of course any concern that has plans of its own is free to stand out of this national effort, but the bigger the concern the graver the responsibilities imposed upon it in this national crisis. The country is doing a great deal for such concerns in protecting them and enabling them to carry on their businesses and to earn their profits. They have a corresponding duty to the country.

"The new company will start with the control of certain good concerns. It hopes to get others. It will extend its operations in every direction in order best to meet the emergency. It will have ramifications of a character that should enable it to do this with success.

"If the whole scheme falls through, the users of dyes and those trades dependent on dyes will be in grave straits. A national effort such as this, with substantial Government aid and the co-operation of those concerned, is bound to succeed. A confession of impotence now would indeed be a national humiliation. The Germans may resolve to keep their best dyes, and by their aid endeavour to build up their textile and other trades in foreign markets, or they may decide to charge double or quadruple prices here for such dyes as they may be willing to sell to us when the war is over. The risks involved in putting up some capital now in this co-operative scheme are absolutely negligible when such risks are duly considered, and when the assured benefits of the scheme are taken into account."

Writing to the "Morning Post" on Jan. 19th, Prof. H. E. Armstrong suggests that a general meeting of the Royal Society be called forthwith to organise the body corporate in the service of the State. It will be impossible, he says, to re-establish the dyestuff or the glass industry, for example, unless such protection be granted as is necessary to place the industry permanently on a footing to meet outside competition unaided. Also, our system of education must be so rearranged that our commercial men are trained to work with scientific assistants and to appreciate their co-operation. Our present position should not be attributed to any failure on the part of science. The re-establishment of the industry must be gradual; to train the necessary army of workers will be very difficult, especially as the number who can give the training is so limited. Some of the most distinguished and successful German workers have been taken into the factory directly from academic positions, and this must be our policy also. But it will be useless to

attempt to train men until a Government guarantee is given to support the industry.

Prof. R. Meldola, President of the Institute of Chemistry, in a letter in the "Times" of Jan. 20th, points out that the Board of Trade Advisory Committee has had nothing to do with the formulation of the Government scheme, and that the Sub-Committee, appointed to deal with this special branch of manufacture, is equally irresponsible. He considers that the weakness of the scheme was in the subordination of science to business in an industry in which science should govern the Directorate. The development of this great industry in Germany has been the result of spending many years and large amounts of capital in research work, and it is to be hoped that we shall not continue to ignore this; if we do, all such schemes are doomed to failure. Scientific control is of primary importance to the industries of this country.

(Further information on this subject will appear in subsequent issues of the Journal.)

Alizarin; Some homologues of—H. Bradbury and C. Weizmann. Chem. Soc. Trans., 1914, 105, 2748—2751.

HEMPINIC anhydride condenses with *o*-xylene, under the influence of aluminium chloride, to form a dihydroxy-2-xylylbenzoic acid, which on dehydration with sulphuric and boric acids gave a mixture of two dimethylalizarins. That melting at 276° C. gave on oxidation pyromellitic acid and is therefore $\alpha\beta$ -dihydroxy- $\beta'\beta'$ -dimethyl-anthraquinone. The other melted at 198° C., and the position of its methyl groups has not yet been determined. Both form orange-yellow needles, dissolve in sodium hydroxide to a purple solution, and dye mordanted cotton. The condensation of 4-methoxyphthalic anhydride with *o*-xylene proceeds in a similar way, giving two hydroxy-xylylbenzoic acids, one of which, m. pt. 228° C., was converted by dehydration into a mono-hydroxydimethylantraquinone crystallising in pale green needles, and melting at 210° C.—G. F. M.

Glucosides of chalkones. G. Bargellini. Gaz. Chim. Ital., 1914, 44, II., 520—528.

MANY chalkones, among them naringenin (4,2',4',6'-tetrahydroxychalkone) and hesperitin (4-methoxy-3,2',4',6'-tetrahydroxychalkone), exist as colouring matters in plants in the form of glucosides. The author succeeded in synthesising glucosides of chalkones by condensing helicin (the glucoside of salicylic aldehyde) with hydroxy-derivatives of acetophenone in alcoholic solution, at the ordinary temperature in presence of a 40% solution of sodium hydroxide, or by heating in presence of piperidine. In this way the glucoside of 2,4'-dihydroxychalkone (minute yellow needles, m. pt. 257°—259° C. with decomposition) was obtained from *p*-hydroxyacetophenone; 2,2'-dihydroxy-4'-methoxychalkone-glucoside (canary-yellow needles, m. pt. 213°—215° C.) from 2-hydroxy-4-methoxyacetophenone; 2,2'-dihydroxy-5'-methoxychalkone-glucoside (orange-yellow needles, m. pt. 225°—227° C.) from 2-hydroxy-5-methoxyacetophenone; 2,2'-dihydroxy-3',4'-dimethoxychalkone-glucoside (bright yellow crystals, m. pt. 195°—196° C. with decomposition) from 2-hydroxy-3,4-dimethoxyacetophenone; and 2-hydroxy-2'-benzalaceto-1'-naphthol-glucoside (minute reddish orange needles, m. pt. 244°—246° C.) from acetone-naphthol (m. pt. 106°—101° C.). In a similar manner tetra-acetylglucovanillin when condensed with peonol yielded the glucoside of 2',4'-dihydroxy-4',3-dimethoxychalkone, canary yellow crystals, m. pt. 220°—225° C.—A. S.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Cellulose acetate; Varnishes and coatings of—
L. Clément and C. Rivière. Bull. Soc. d'Encouragement, 1914, 121, 187—206.

THE most suitable solvent for cellulose acetate is tetrachloroethane, but this gives viscous solutions, often opalescent owing to moisture present in the cellulose acetate. For practical purposes a mixture of tetrachloroethane with 10% of strong methyl or ethyl alcohol is suitable, but as such mixtures are slightly inflammable and the alcohol evaporates more readily than the tetrachloroethane, the use of amyl alcohol in place of the lighter alcohols has been suggested (Fr. Pat. 481,058; this J., 1914, 20). The cellulose acetate is dissolved in mixing machines with moving blades, and the viscous liquid may be filtered under pressure in a filter-press; for the preparation of highly viscous solutions or pastes heated mixing machines are necessary. Artificial silk made from cellulose acetate is said to withstand water better than other kinds, but the cost, and the artificial silk "trust," have prevented its manufacture. Varnishes composed of solutions of cellulose acetates are now being used for rendering aeroplane fabrics impermeable. Suitable mixtures are: (1) tetrachloroethane, 900; denatured 95% alcohol, 100, and cellulose acetate 75 grms.; and (2) tetrachloroethane, 800; denatured 95% alcohol, 80; acetone, 120; and cellulose acetate 65 grms. Two or three coats of about 500 grms. per sq. metre are applied to the fabric stretched on the chassis. The fabric so treated is said to possess advantages over rubbered fabrics in regard to impermeability to water and resistance to oil and motor spirit. It is suggested that cellulose acetate solutions might be used in the textile printing industry as thickening agents instead of gum or starch, and as resists in dyeing.—R. G. P.

PATENTS.

Sulphite fibre; Process of making—and *reclaiming sulphur dioxide*. H. K. Moore and R. B. Wolf, Berlin, N.H. U.S. Pat. 1,119,977, Dec. 8, 1914. Date of appl., Feb. 1, 1910.

THE raw material and aqueous liquor are charged into a digester, which is then closed, and sulphur dioxide is injected to provide an excess of sulphurous acid, the air being allowed to escape. The charge is allowed to stand, without heating, while the acid permeates the material, and steam is injected until the cooking is completed, sulphur dioxide being again passed in to compensate for the weakening of the solution by condensed water. The liquor and gases are discharged and separated, the sulphur dioxide being removed from the other gases by liquefaction.—B. N.

Viscose solution from wood-cellulose; Method of manufacturing a—A. Bernstein, Chemnitz, Germany. U.S. Pat. 1,121,605, Dec. 22, 1914. Date of appl., Aug. 22, 1913.

SEE Fr. Pat. 462,147 of 1913; this J., 1914, 196.

Artificial lustrous threads, etc.; Process of manufacturing—F. E. Dietler, Assignor to Verein. Kunstseidefabriken A.-G., Kellsterbach on Maine, Germany. U.S. Pat. 1,121,903, Dec. 22, 1914. Date of appl., June 18, 1912.

SEE Fr. Pat. 443,621 of 1912; this J., 1912, 1027.

Composition [from sulphite-cellulose waste lye] for laying road-dust. U.S. Pat. 1,119,500. See IX.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

PATENTS.

Washing machines; Rotary cylinder—I. Braithwaite and Son, and R. J. W. Cousins, Kendal, Westmoreland. Eng. Pat. 28,565, Dec. 11, 1913.

THE washing machine comprises a rotary cylinder with a conical base ending in a trunnion serving as the discharge outlet, through which the clear liquid and steam are supplied. The axis of the cylinder is slightly inclined to the vertical. When the liquid reaches a given level the vessel is emptied through a siphon discharging into a chamber provided with two movable buckets counter-balanced by a weight. The movement of the buckets opens and closes the outlet and inlet valves, so that the action of the machine is continuous.—B. N.

Bleaching textile materials and other substances. J. E. Macilwaine, Belfast. Eng. Pat. 28,911, Dec. 15, 1913, and 6317, March 12, 1914.

THE material is impregnated with a solution of sodium bicarbonate and then with the hypochlorite bleaching liquor, or the order of impregnation may be reversed, the active bleaching agent in either case being liberated in the body of the fibre. Mechanical or other pressure may be applied to intensify the process of impregnation.—B. N.

Dyeing yarns and shubbings; Machines for—S. S. Partridge, Kidderminster, Worcester. Eng. Pat. 3114, Feb. 6, 1914.

A HANK-CARRYING frame is given a vertical reciprocating movement in a vat by means of mechanism, as described in Eng. Pat. 8570 of 1904 (this J., 1905, 543), and at one end of the vat is arranged a compartment provided with an agitator for the liquid. The liquid is circulated between this compartment and the vat, whilst the yarn is prevented from entering the compartment and becoming entangled with the agitator.—B. N.

Dyeing-spool. J. G. Masson, Woonsocket, R.I. U.S. Pat. 1,120,398, Dec. 8, 1914. Date of appl., July 18, 1913.

A TUBULAR spool is provided with a series of perforated walls, with deep annular grooves, between which the goods are wound in comparatively thin separated rows, so that the dyeing liquid may be forced through each row from either side. A jacket of perforated material encloses the spool when charged.—B. N.

Dyeing machine. J. Benosch, Assignor to Klaunder-Weldon Dyeing Machines Co., Amsterdam, N.Y. (A) to (E). U.S. Pat. 1,120,643 to 1,120,647, Dec. 8, 1914. Dates of appl., (A)—(C) Dec. 13, 1913, (D) March 9, 1914, (E) March 10, 1914.

(A) A FRAME is formed of central and outside spiders, with two sets of yarn sticks carried on them by means of a pair of adjacent sockets opening in opposite directions, and the frame is mounted so as to turn within an outer casing. Intermittent rotation of the yarn sticks is produced by mechanism connected with one of the spiders. (B) The yarn sticks are carried by a pair of rotary members, one end of each stick resting in one of the members, whilst the second member is provided with slides which lock and release the sticks in groups. (C) The yarn sticks are

supported between a pair of rotary carrying members, sockets upon one of the members being adapted to receive one end of each stick, whilst the other member is flanged and has sockets, each of which has its outer side open. A slide, beneath the flange, is provided with a number of projections passing through slots in the carrying member, the slots being of such a length that the projections may be moved into and out of register with the sockets and the sticks held in position. The slide is locked in position by a screw passing through the flange. (D) The rotary frame, supporting the yarn sticks, is provided with mechanism so arranged that the sticks are rotated as they pass a trip member, but in one direction only. The member may be set, however, to move the sticks when the frame is moved in the opposite direction. (E) The sticks are supported in non-circular sockets, and means are provided for rotating the sticks intermittently in one direction only, independent of the movement of the frame.—B. N.

Dyeing machine. W. W. Brown, Assignor to Klauder-Weldon Dyeing Machine Co., Amsterdam, N.Y. U.S. Pat. 1,120,899, Dec. 15, 1914. Date of appl., April 28, 1914.

THE yarn sticks are carried in a support and rotated by mechanism engaging with a trip member, which is operated by a weighted lever arranged so that it yields on the application of unusual pressure, whereby movement of the trip member is resisted to cause tripping. Means are also provided for regulating the pressure.—B. N.

Dyeing machine. J. Benosch, Assignor to Klauder-Weldon Dyeing Machine Co., Amsterdam, N.Y. U.S. Pat. 1,121,064, Dec. 15, 1914. Date of appl., March 9, 1914.

A NUMBER of cups are supported on a rotary carrier; each cup opens away from the axis of the carrier, and is adapted to receive the end of a yarn stick. The sticks are forced into the cups, and are retained in position by a sliding member on the carrier actuated by a spring.—B. N.

Dyeing straw and the like; Vat for—A. Kluge, Brooklyn, N.Y. U.S. Pat. 1,121,023, Dec. 15, 1914. Date of appl., Oct. 4, 1913.

A PERFORATED support is fixed a little above the bottom of the vat, and a "puffer" is connected to the centre of the support. A perforated pipe is fixed parallel and adjacent to the edge of the bottom of the vat, the perforations being directed towards the bottom of the vat and the lower end of the vertical pipe.—B. N.

Dyeings; Producing stable—A. Schlegel, Mannheim, and K. Pfister, Philadelphia, Pa., Assignors to Badische Anilin und Soda Fabrik, Ludwigshafen on the Rhine, Germany. U.S. Pat. 1,121,295, Dec. 15, 1914. Date of appl., Dec. 4, 1913.

THE material is passed through a paste of a vat colouring matter of the anthracene series, and the colouring matter is fixed on the fibre by a single short passage through a warm solution containing about 3 or 4 parts of sodium hydrosulphite in 100 parts of water.—B. N.

Dyeing process. J. A. Dominguez, Buenos Aires. U.S. Pat. 1,121,720, Dec. 22, 1914. Date of appl., Oct. 9, 1911.

SEE Addition of Dec. 13, 1911, to Fr. Pat. 437,020 of 1911; this J., 1912, 637.

Cotton fabrics; Process for the production of pattern effects upon—Heberlein et Cie., Wattwil, Switzerland. Eng. Pat. 13,129, May 28, 1914. Date of appl., Nov. 20, 1913.

SEE Fr. Pat. 468,642 of 1914; this J., 1914, 960.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Carbonic acid; Detection of—, especially in mixtures of carbonate and sulphite. J. Petersen. Z. anorg. Chem., 1914, 88, 234—236.

TO the mixture of carbonate with sulphite, etc., hydrochloric acid and a few strips of zinc are added, and the gases evolved are passed at the rate of 2 to 3 hubbles per second through a wash-bottle containing 3% hydrogen peroxide and then into a fairly large volume of lime-water; the solubility of calcium sulphite in water being 1 in 800, the small quantity formed from the traces of sulphur dioxide remaining in the gas, will be dissolved, and any precipitate will be due to the presence of carbon dioxide. If chlorine is evolved the dilute hydrogen peroxide is replaced by potassium iodide solution.—J. R.

Acid sodium borates. J. Ponomareff. Z. anorg. Chem., 1914, 89, 383—392.

FUSED mixtures of borax with varying proportions of boron trioxide were made to crystallise by placing in a platinum boat in a definite temperature gradient, so that for at least one layer favourable conditions for crystal formation were produced (see Tammann, this J., 1914, 691). Three definite maxima were observed at 732°, 694°, and 783° C., indicating the existence of definite acid borates of the formula: $\text{Na}_2\text{O}, 2\text{B}_2\text{O}_3$, $\text{Na}_2\text{O}, 3\text{B}_2\text{O}_3$, and $\text{Na}_2\text{O}, 4\text{B}_2\text{O}_3$; respectively. These three compounds form mixed crystals with each other, and the most acid of them can take up still more boric anhydride, so that it is possible to obtain crystals containing only 3% Na_2O , the nearest approximation to crystallised boric anhydride so far obtainable.—G. F. M.

Cathode rays; Salts coloured by—E. Goldstein. Brit. Assoc., Australia, 1914. Chem. News, 1915, 111, 27—29.

THE incidence of cathode rays on certain salts produces immediately vivid colours on the salts which in the dark and at low temperatures may persist in some cases for many years (Wiedem. Ann., 54, 371; 60, 401; Phys. Zeits., 3, 149; Sitzungsber. Berl. Akad. Wiss., 1901, 222; see this J., 1901, 1240). Thus, sodium chloride becomes amber-coloured, potassium chloride violet, potassium bromide deep blue, sodium fluoride rose, lithium chloride bright yellow, and potassium carbonate reddish. The colours are sensitive to heat in very different degrees; for instance, that of sodium chloride is comparatively stable, but those of potassium chloride and bromide disappear even at tropical temperatures. The disappearance of colour in daylight is generally accompanied by the appearance of marked fluorescence. Similarly solid solutions of these salts even in extreme dilution, in substances such as potassium or sodium sulphate, which are not themselves affected by cathode rays, also acquire characteristic colours, generally different from the colour given by the pure substance. Thus, one part of potassium carbonate in 25,000 parts or more of the sulphate produces a green colour, whilst in some cases quantities of an admixture estimated at one part in one million, may produce

a perceptible tint. These reactions afford a very sensitive method for detecting impurities in salts, even when more than one impurity is present, since the colours produced by different impurities generally disappear at different rates in daylight or on increasing the temperature. Potassium sulphate, for example, generally turns dark grey at first, owing to the presence of a trace of sodium chloride, but this colour disappears in a short time in daylight, leaving only a vivid green due to the carbonate. Potassium sulphate may be obtained so pure by repeated fractional crystallisation, that it is no longer coloured by cathode rays; on the other hand, it has not been possible to separate from sodium sulphate by this method the last traces of carbonate, as indicated by the persistent grey shade produced by the rays. There is thus a marked difference between these so-called "first-class colours" and the Giesel colours which are produced by heating the substance in the vapour of one of its components, sodium chloride in sodium vapour, for example (see Ber., 30, 156). In this latter case the decomposition is permanent, the salts have a strong alkaline reaction, and the colour is not at once destroyed by daylight. However, by submitting salts to the action of cathode rays for a somewhat prolonged time, until the salts are strongly heated, products identical in every respect with the Giesel salts are obtained. Since the colorations produced by different salts of the same metal vary so much, it is probable that they are due, primarily to the acidic radical. This assumption is strengthened by the fact that the halogen derivatives of acetic acid are coloured by the cathode rays, whilst acetic acid itself remains colourless. These phenomena are probably accounted for by a decomposition, not, however, of the ordinary kind in which the components are entirely set free, but merely a "distention," the components remaining at a short distance from one another, and if the absorptive power is weakened by heating, or the chemical affinity strengthened by the energy of daylight, recombination again ensues. The effects of cathode rays and β -rays are really the effects of the ultraviolet light produced by the stopping of those rays, and hence ultra-violet light also produces similar colour effects on salts. The therapeutic effect of X-rays, radium, etc., according to this view, would be merely the effect of the ultra-violet light produced on any surface whereon the rays are stopped.

Radium. Report presented to the House of Representatives, U.S.A. Chem. News, 1914, 110, 264—266, 276—278, 284—286, 301—302, 310—312. (See also this J., 1913, 1066, 1107.)

THE Committee on Mines and Mining report, with the recommendation that it be passed, "a Bill to provide for and encourage the prospecting, mining, and treatment of radium-bearing ores in lands belonging to the United States for the purpose of securing an adequate supply of radium for government and other hospitals in the United States, and for other purposes." The general scope of the bill is to provide the Government with a preferential right to purchase radium-bearing ores from lands now owned by the Government, at prices to be fixed semi-annually by the Secretary of the Interior, under such conditions as will ensure and encourage prospecting and mining. It does not reserve to the United States the ownership of radium-carrying ores, but furnishes the actual prospector with a steady market for his ores. The bill further authorises an appropriation to cover the cost of the mining of the radium-bearing ores on the public lands, and the extraction of the radium. The Secretary may sell to American

hospitals, at cost of production, a part or all of the radium produced.

During the last two or three years the U.S. production of the raw radium material was from two to three times as much as that of the rest of the world together, but up to Jan. 1st, 1914, only 2 grms. of radium had been actually isolated in the States, and such was the foreign demand for raw material that it was practically impossible to procure radium for immediate delivery. Since some of the pure radium salt had also been exported there is probably less than 2 grms. in America to meet the entire demand of some 200,000 cancer cases. About 1000 claims, many of them by foreign interests, have already been staked out in the carnotite deposits of Colorado and Utah, the most extensive radium-bearing deposits in the world. The deposits have been very wastefully exploited, four tons of low-grade ore having been thrown away for every ton marketed. The testimony presented to the Committee as to the future supplies was contradictory, and prompt action by the Government to secure the deposits already located is therefore necessary in view of this uncertainty, and the fact that, although the carnotite region covers over 480,000 acres, the individual pockets are small, unconnected by veins, and have produced in the most favourable cases less than 500 tons of ore suitable for export. From the ores exported in 1912, 11.43 grms. of anhydrous radium bromide could, and probably have been prepared, and, in 1913, 7.5 grms. The report concludes with a statement of the requirement of radium in America for cancer treatment, and of the impossibility of obtaining it at a reasonable price other than by government operation.

Appendix I. U.S. radium resources. C. L. Parsons. U.S. Bureau of Mines. American carnotite from Montrose and San Miguel counties, Colorado, including the Paradox valley deposits, and from Green River and other places of lesser importance in Utah, are at the present time the principal sources of radium in the world. Apart from the deposits at Joachimsthal, Bohemia, pitchblende is of quite secondary importance, the only other deposits of any size being in Gilpin County, Colorado, where small quantities have been mined. Since 1896 carnotite has been spasmodically worked by various companies for uranium and vanadium, and first in 1903 for radium but without success. In 1910 the Standard Chemical Co. and the International Vanadium Co. successfully engaged in mining carnotite, but most of the high-grade ores have been exported to Europe for radium extraction, and the low-grade ores wasted. Mechanical concentration of the latter would save half of the material now thrown away. An estimate placing the amount of radium in the Colorado carnotite deposits at 900 grms. is five times as large as that made by the Bureau of Mines. (See also this J., 1913, 616, 1107.)

Appendix II. National Radium Institute (see this J., 1913, 1066).—G. F. M.

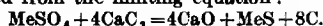
Carnotite near Mauch Chunk, Pennsylvania. E. T. Wherry. Bulletin 580-H., U.S. Geol. Survey, Washington, 1914.

THE occurrence of carnotite near Mauch Chunk, Pa., was first noted in 1908; the mineral occurs in a 40-foot layer of coarse-grained conglomerate lying near the base of the Pottsville formation, the rock consisting chiefly of white quartz, but also of gneiss, crystalline limestone, and serpentine. A sample of the carnotite separated from gangue contained V_2O_5 9.80%; UO_2 31.11; K_2O 3.55%. Analysis of a small specimen of the rock showed 4.4% UO_2 , but it is doubtful whether much of the material contains more than 1%. However, as

the cost of transport to consumers would be far less than for the Colorado ores, a profit of £5 per ton is possible even on 1% ore, and further prospecting of the deposit is recommended.

Radium; Preparation of — from "crude sulphate" by means of calcium carbide and mixtures of calcium carbide and calcium hydride. E. Ebler and W. Bender. *Z. anorg. Chem.*, 1914, 88, 255—264.

"CRUDE sulphate" mixtures containing radium could not be satisfactorily reduced with carbon, silicious and other impurities preventing reduction of the radium. The "crude sulphate" from torbernite, autunite, carnotite, and other important sources containing very little radium and much silicious matter, was satisfactorily reduced with calcium carbide by maintaining at a bright red heat for 4 hours, the amount of carbide being estimated from the limiting equation:



The greyish-black product was powdered and freed from sulphide as rapidly as possible by boiling with dilute hydrochloric acid, whereby the radium was obtained in the filtrate in company with Ba, Ca, Fe, and Pb (if present). The autogenous reduction of the "crude sulphate" with calcium hydride (see this J., 1913, 976) may become extremely vigorous in presence of certain impurities; the process was conveniently moderated by the addition of calcium carbide, the amount of calcium hydride being chosen so as to render the reaction just autogenous. With very pure "crude sulphate" up to 75% of the hydride could be replaced by carbide. The reduction was complete in a few minutes. The percentage yields of radium increased with the total charge up to 50 kilos. The reduction is attributed to the action of calcium vapour.—J. R.

Calcium carbide; Note on the preparation of pure —. M. D. Thompson, L. R. Gonzalez, and K. B. Blake. *Met. and Chem. Eng.*, 1914, 12, 779—780.

PURE calcium carbide, in quantities large enough for experimental purposes, was prepared by the action of acetylene on calcium dissolved in anhydrous liquid ammonia. The carbide made in this way is acted upon by atmospheric moisture with such intensity that the acetylene produced is ignited. A stable product may be obtained by allowing it to stand in an atmosphere of acetylene.—W. E. F. P.

Peroxides of the alkaline earths. E. H. Riesenfeld and W. Nottelbohm. *Z. anorg. Chem.*, 1914, 89, 405—412.

THE peroxides of barium, strontium, and calcium can be obtained either anhydrous, or as octohydrates, or as diperoxyhydrates, according to the temperature and concentration of the solutions from which they are precipitated. The anhydrous peroxides of calcium and strontium are precipitated by hydrogen peroxide from concentrated solutions at high temperatures. All three anhydrous peroxides are also obtained by the careful drying of any of the hydrates. The octohydrates are in general produced when cold fairly dilute salt solutions containing hydrogen peroxide are rendered alkaline. If excess of peroxide is present a diperoxyhydrate is precipitated from cold solutions of barium salts, but the corresponding strontium and calcium peroxide diperoxyhydrates are only obtained by the action of concentrated hydrogen peroxide on the octohydrates at low temperatures. Barium peroxide also forms a monoperoxyhydrate, obtained by precipitating between 30° and 60° C., and calcium peroxide can be obtained as a dihydrate.—G. F. M.

Copper sulphates; Basic —. Fonzes-Diacon. *Bull. Soc. Chim.*, 1914, 15, 723-727.

WHEN a solution of sodium carbonate is poured slowly into a solution of copper sulphate, the latter being vigorously agitated, a basic copper sulphate, $\text{CuSO}_4 \cdot 3\text{CuO} \cdot 4\text{H}_2\text{O}$, is first formed. As the concentration of the copper sulphate decreases, a hydrate of the type, $\text{CuSO}_4 \cdot 4\text{CuO} \cdot n\text{H}_2\text{O}$, is produced. Excess of sodium carbonate decomposes these basic sulphates with the formation of copper hydrocarbonate. When the supernatant liquor containing excess of copper sulphate is exposed to the air a blue compound, $\text{CuSO}_4 \cdot 3\text{CuO} \cdot 5\text{H}_2\text{O}$, or a green compound, $\text{CuSO}_4 \cdot 3\text{CuO} \cdot 4\text{H}_2\text{O}$, is deposited. (See also Ermen, this J., 1912, 312; Fowles, 1913, 9.)—F. SHDN.

Oxides of lead; The higher — and their dissociation. W. Reinders and L. Hamburger. *Z. anorg. Chem.*, 1914, 89, 71—96.

THE dissociation pressure of Pb_2O_3 was determined at temperatures between 440° and 610° C., and it was found that the results could be represented satisfactorily by either of the equations:

$$(1) \log p = -\frac{35926}{4 \cdot 571T} + 11 \cdot 8976, \text{ or}$$

$$(2) \log p = -\frac{32406}{4 \cdot 571T} + 1 \cdot 75 \log T + 0 \cdot 000216T + 2 \cdot 8.$$

The heat of formation of Pb_2O_3 from PbO and O_2 was calculated to be 35,926 and 35,954 cal. at 550° C. by equations (1) and (2) respectively and 33,504 cal. at 17° C. by equation (2). When lead dioxide is heated there are formed not definite chemical compounds but solid solutions of oxides, of composition ranging from PbO_2 to $\text{PbO}_{1.33}$ at 361° C. (or to $\text{PbO}_{1.33}$ at 381° C.). The dissociation pressure varies considerably with the composition of the products. These oxides are metastable in comparison with Pb_2O_3 , and the latter is formed when PbO_2 or an oxide PbO_x ($x > 1.33$) is heated to 420° or higher in oxygen under pressure. Pure Pb_2O_3 can be obtained by heating PbO at 440° C. under an oxygen pressure of 2 atmospheres. Lead oxides containing active oxygen, prepared by wet methods, change colour when heated, and show the same behaviour as the products of dissociation of PbO_2 . (See also Milbauer, this J., 1909, 612, 1049; 1910, 282; 1911, 37; 1912, 193; 1913, 97, 151.)—A. S.

Hydrosols; Influence of the quantity of peptising agent on the properties of —. *Hydrosol of stannic acid.* R. Zsigmondy. *Z. anorg. Chem.*, 1914, 89, 210—223.

HYDROSOLS of stannic acid (0.5% SnO_2) were prepared by treating stannic acid gel with varying quantities of potassium hydroxide free from carbonate, in the proportions corresponding to 200, 100, 50, 25, 10, and 2 mols. SnO_2 respectively per mol. KOH . With increasing quantity of alkali, the size of the colloidal particles, the amount of colloidal stannic acid transferred under the influence of the electric current, the gold number (this J., 1902, 192), and the viscosity of the sol decreased; the stability on boiling, the osmotic pressure, the electric conductivity, and the quantity of electrolyte required to effect precipitation increased, and the surface tension remained unaltered or diminished slightly. The differences observed are explained by the author's theory of peptisation, according to which the added alkali forms alkali stannate and peptisation is produced by adsorption of the stannate ions by the colloidal ultramicros of the stannic acid gel, whereby they become electrically charged. It is suggested that sols prepared from gels by peptisation with alkalis or acids, and of which

the properties change gradually and continuously from those of a colloidal to those of a true solution, as the quantity of peptising agent is increased, should be grouped as a separate class of colloids, for which the name "electrolyte-colloids" is proposed.—A. S.

Potash; Felspar as a possible source of American
A. S. Cushman and G. W. Coggeshall.
Amer. Inst. Chem. Eng., Dec. 2, 1914. Oil,
Paint, and Drug Rep., Dec. 14, 1914, 32A—32B

IN 1914 the U.S.A. imported potassium salts to the value of \$15,000,000, including chloride of the value of \$8,000,000. Most of this, including 85% of the chloride, was utilised in the fertilising industry; and the remainder of the chloride was converted chiefly into hydroxide, carbonate, chlorate, and bichromate. Most of the American sources of potash, namely, the kelps, saline lakes and wells, and alunite deposits, are situated in the West, whereas the demand exists east of the Allegheny mountains; and it is considered unlikely that the Panama Canal will enable Western potashes to compete with the European product. On the other hand, the great Appalachian felspar dykes are close to the centres of demand. In the process described, a mixture of ground felspar (10% K₂O) and burnt limestone is formed into "clumps" by treatment with calcium chloride solution and heated in a rotary kiln, the fuel being oil or powdered coal. The red-hot product falls into lixiviating vats. The weaker vat-liquors are used in a further operation, while the stronger ones are concentrated by spraying through the waste hot gases, whereby loss of potassium chloride by volatilisation is also prevented. The product, after drying in a rotary dryer which utilises the hot waste gases of the lime-kiln, contains 70—80% KCl, 14 to 18% NaCl, and small amounts of calcium salts and moisture, as against 70 to 80% KCl in the imported "80% muriate." A high-grade product can be obtained by fractional crystallisation. The general plant, in the main, resembles a Portland cement mill. The total cost of a plant to handle 300 tons of felspar per 24 hours is given as \$100,000 for the general plant, with an additional \$70,000 for the special equipment. The estimated total expenditure per day of \$1488.90 is composed of \$800 for raw materials, \$554.60 for manufacturing operations, and \$64.30 for charges, including interest and depreciation. Calculating on the basis of an 80% conversion of K₂O to KCl, the cost of the product amounts to \$31.32 per ton, as against \$37.50 for the normal price of the imported "80% muriate," which latter, however, is probably artificially controlled. No account is taken in these estimates of possible valuable by-products. Since all the requisite materials are available in the country, the authors consider that the U.S.A. might be rendered independent of foreign supplies.—J. R.

Ammonia; Determination of —, by the boric acid method. L. W. Winkler. Z. angew. Chem., 1914, 27, 630—632.

IN applying the boric acid method (this J., 1913, 485) to the determination of nitrogen by the Kjeldahl process, the distillate (200 to 300 c.c.) from the ammoniacal liquid is passed into a cooled receiver containing boric acid (10 grms.) in distilled water (100 c.c.). A narrow-necked receiver, e.g., a Soxhlet flask, is preferable, and the mouth should be closed with a wad. The distillate is titrated with N/10 or N/5 hydrochloric acid, using either Congo-red (1 in 1000) or methyl-orange (1 in 1000). For great accuracy water free from carbonic acid is employed, a boric acid solution containing the same amount of indicator is used as a colour standard, and the hydrochloric acid is standardised by distilling a weighed quantity

of pure ammonium chloride with alkali under similar conditions. The method, which is recommended for general use, gave results of high accuracy (e.g., 0.1790 grm. NH₃ instead of 0.17846 grm.) when the above precautions were observed.

—J. R.

Ammonia production in the United Kingdom in 1914. Bradbury and Hirsch, Liverpool. Jan., 1915.

PRODUCTION of ammonia, calculated into sulphate (including that used in the manufacture of ammonia soda and for other chemical purposes), from all sources in the United Kingdom during 1914, is estimated at 421,000 tons, viz. :—

	1913.	1914.
	tons	tons
Gas works	132,000	177,000
Iron works	20,000	19,000
Shale works	63,000	62,000
Coke and carbonising works and producer gas	167,000	163,000
	432,000	421,000

Of this quantity it is estimated that England contributed 295,000 tons, Scotland 123,000 tons, and Ireland 3,000 tons. Exports during 1914 amounted to 314,000 tons and home consumption to 106,000 tons, leaving a stock of 25,000 tons to carry forward to 1915.

Strontia in the beet sugar industry. Meyer. See XVII.

PATENTS.

Ammonia by synthesis; Process for utilising gas producers for the manufacture of —. A. Bambach. Fr. Pat. 460,331, Feb. 28, 1914.

A gas producer is operated in the normal manner with atmospheric air, but with a charge of fuel which has been treated with metallic salts, oxides, hydroxides, or carbides. Metallic nitrogen compounds (cyanides, cyanamide, nitrides, etc.) are thus formed, and these are decomposed *in situ* by steam or atomised water, so as to produce ammonia, which is carried forward by the gaseous current, and oxides or salts which are recovered from the ash. The air is preferably preheated, and the gases containing ammonia are suddenly chilled by a cooling coil in the centre of the producer, surrounded by a perforated iron drum connected with an exhaust. Supplementary substances, such as small proportions of magnesium chloride, calcium fluoride, etc., may be added to the charge, to increase the yield of ammonia and the speed of the reaction.—F. SODN.

Salt; Process of purifying and sterilising [common]
— E. D. F. Barry. Fr. Pat. 460,241, May 14, 1913.

THE salt is crystallised from water and brought in contact with heated air in a drying stove, being preferably introduced into the upper part of the stove and allowed to fall through air at not less than 140° C. The product is packed under aseptic conditions, for example, in an ozonised atmosphere.—F. SODN.

Aluminium nitride; Process of making —. Soc. Générale des Nitrures. Second Addition, dated May 13, 1913, to Fr. Pat. 427,109, May 19, 1910 (see Eng. Pats. 13,086 of 1910 and 22,435 of 1912; this J., 1911, 421; 1913, 233).

THE preliminary heating is effected in an extension of the main reaction tube, which is supplied with

air and serves for the combustion of the reaction gases. The bauxite may be calcined by direct contact with the flame, whilst the carbon is heated in a coil surrounding the tube and introduced at a point behind the flame. Or the mixture of bauxite and carbon may be heated together, out of contact with the flame, by passing through an axial tube in the combustion zone, or by traversing a coil, preferably of increasing section, built in the lining of the furnace, so as to deliver behind the flame; in the latter case, steam evolved from the material is carried forward into the flame, rendering the temperature more uniform.—F. SODN.

Nitrides [especially aluminium nitride]; Electric furnace principally for the manufacture of— and its mode of utilisation. G. Coutagne. Fr. Pat. 469,554, May 23, 1913.

A PAIR of vertical electrodes is disposed axially in a gas-tight metallic envelope, the upper one being movable, whilst the lower is fixed and consists of a thick-walled tube of agglomerated carbon, filled with coke. Producer gas or other nitrogenous gas is introduced into the lower electrode under pressure from below. The envelope is provided with an exit pipe for residual gas and air-tight charging doors, and the space between it and the lower electrode is packed with refractory material, the upper part of the envelope being protected only by the peripheral portion of the charge (e.g., a mixture of bauxite and carbon) which escapes reaction. The furnace is started by lowering the upper electrode, and the charge is then introduced intermittently, until the furnace is full, when it is allowed to cool and the product withdrawn by removing certain readily dismantled sections from the upper part of the envelope. The cake of nitride is detached from unagglomerated material, and particles of included metal are separated by crushing and treating with a magnet or exposing to steam or water, which cause such particles to fall into powder.—F. SODN.

Nitrous gases; Process for the gradual absorption of dilute— by means of water. F. Häusser. Fr. Pat. 469,649, March 14, 1914.

ABSORPTION vessels of relatively small size are made to alternate with oxidation chambers, so that the gases pass through each in succession, whilst the absorbing liquid gravitates from one absorption vessel to the next.—F. SODN.

Perborates [of magnesium and zinc]; Process for making— Henkel und Co. (A) First and (B) Second Additions, dated Feb. 11 and 12, 1914, to Fr. Pat. 468,293, Feb. 10, 1914 (this J., 1914, 962). Under Int. Conv., Feb. 21 and 27, 1913.

(A) A MAGNESIUM salt or (B) a zinc salt of an acid which forms an alkali salt containing water of crystallisation, is mixed with an alkali peroxide, borax, and a substance reacting with the excess of alkali (e.g., boric acid), the mixture is allowed to absorb about 25% of water, and is then melted by heating for some time, with stirring, preferably at about 65° C., and the solidified product is crushed, dried, and powdered.—F. SODN.

Elements; Process of obtaining— from their volatile compounds. Ehrlich und Gractz, and E. Podszus. Fr. Pat. 469,355, March 5, 1914. Under Int. Conv., March 19, 1913.

VOLATILE compounds (e.g., chlorides of V, Ti, B, etc.) are brought into contact with an excess of strongly heated metallic vapour produced in a metallic vapour arc, and the products are rapidly cooled and subsequently separated by distillation, preferably *in vacuo*, to obtain the reduced element

in the pure state. The vapour to be treated may be introduced into a horizontal tube, in which are one or more mercury vapour arcs (perpendicular to the tube or at an angle), rendered stable as described in Ger. Pat. 227,270 of 1908, an adjustable mercury cathode functioning within a "stabilising tube" which is fitted detachably to the main tube.—F. SODN.

Liquid air; Process of, and apparatus for separating— into its constituents. G. Hildebrandt, Berlin. Assignor to American Industrial Gas Co., New York. U.S. Pats. 1,119,158 and 1,119,159, Dec. 1, 1914. Dates of appl., Oct. 16, 1912, and Sept. 26, 1913.

AIR is liquefied by cooling, compressing, and expanding, and the liquid air is separated into its constituents by fractionation whilst passing in thin streams through a long conduit. Nitrogen is collected at the head and liquid oxygen at the base of the conduit; the former is used to cool the unexpanded compressed air, and evaporation of the liquid oxygen serves to heat the rectifying conduit.—W. C. H.

Furnace; Electric— particularly adapted for the manufacture of nitrides. G. Coutagne, Lyons, France. Eng. Pat. 12,057, May 15, 1914. Under Int. Conv., May 23, 1913.

SEE Fr. Pat. 469,554 of 1913; preceding.—T. F. B.

Perborate of zinc; Process of manufacturing— W. Weber, Assignor to Henkel und Co., Düsseldorf, Germany. U.S. Pat. 1,121,428, Dec. 15, 1914. Date of appl., Feb. 9, 1914.

SEE Addition to Fr. Pat. 468,293 of 1914; preceding.—T. F. B.

Improving the quality of inorganic solid materials [minerals coloured by iron compounds]. Fr. Pat. 469,271. See VIII.

VIII.—GLASS; CERAMICS.

Optical glass and scientific instruments. United Kingdom imports and German exports. Nature, Jan. 7, 1915.

IMPORTS of scientific instruments and apparatus (other than electrical) complete into the United Kingdom in 1913 amounted to £710,341 in value, of which Germany contributed £362,891, France £108,040, Belgium £28,938, and the United States £182,293. Parts of scientific instruments (including cinematograph films and photographic plates, films, and paper) were imported to the value of £2,373,426, including £310,229 from Germany, £522,682 from France, £126,725 from Belgium, and £1,256,311 from the United States. The exports from Germany to the United Kingdom in 1912 included the following:—Optical measuring instruments (polariscopes, etc.), nautical, astronomic, and geodetical instruments, £15,615; precision balances, instruments for metrology and gauging, barometric, calorimetric, thermometric, and like apparatus, £19,800. Exports of terrestrial telescopes and opera glasses of all kinds from Germany in 1912 were valued at £350,000, Russia receiving these goods to the value of £83,050, Austria £50,930, and the United Kingdom £34,430. Other optical glass, ground and mounted (telescope objectives), stereoscopes, microscopes, and unmounted lenses were exported to the value of £229,500, including £31,430 to the United Kingdom, £30,000 to Russia, and

£23,740 to the United States. Photographic apparatus, including lenses, amounted to £370,000, including £65,000 to the United Kingdom, £51,000 to Russia, and £54,000 to Austria. Glass thermometers, combined or not with other materials, represented £122,000, of which Russia took £18,000, Austria £12,700, and the United Kingdom £12,600. Exports from Germany of apparatus and instruments of glass (including glass tubes), combined or not with other materials, totalled £290,000, including £50,000 to the United States, £40,000 to the United Kingdom, and £47,600 to Russia.

PATENTS.

Glass sheets; Manufacture of—F. L. O. Wadsworth, Sewickley, Pa. U.S. Pat. 1,119,328, Dec. 1, 1914. Date of appl., March 12, 1908.

A PAIR of co-operating rolls is rotated so that a portion of the surface of each roll is in contact with a mass of molten glass. A vacuum is created between the molten-glass and the portions of the roll surfaces in contact with it, and maintained between the glass and successive portions of the roll surfaces as they move away from the mass of glass. A layer of glass is thus continuously drawn from the mass in contact with each moving roll surface and the vacuum is gradually relieved as the layers are compressed between the rolls.

—W. C. H.

[*Reinforced*] *sheet-glass; Manufacture of*—F. L. O. Wadsworth, Sewickley, Pa. U.S. Pat. 1,119,320, Dec. 1, 1914. Date of appl., April 13, 1909.

A ROLL is immersed in a mass of molten glass to a point above its axis, and means are provided, with a suitable tension device, for guiding the layer of reinforcing material, to be embedded in the sheet, on to one side of the roll and withdrawing it, when embedded, from the main mass of the glass on the opposite side. A free body of glass is maintained on substantially the same level as the glass in the receptacle between the roll and the outwardly moving layer of reinforcing material, and above the plane where the latter passes out of contact with the roll. Between the guide and the drawing mechanism, means are provided for embedding the reinforcing layer in the glass, such means being vertically movable by variations in the tension and rate of drawing of the layer.—W. C. H.

Inorganic solid materials [e.g., sand for glass making, coloured by iron compounds]; Process for improving the quality of—F. Schulz, Jun. Akt.-Ges., and H. Gruber. Fr. Pat. 469,271, March 6, 1914.

THE material is treated with hydrosulphurous acid or its derivatives, or with aldehyde- or ketone-sulphoxylic acids or their derivatives in the presence of an acid. For example, 500 grms. of concentrated sulphuric acid (previously diluted) are stirred into a mixture of 100 kilos. of sand (for glass making) and 100–200 litres of water, to which have been added 100–200 grms. of hydrosulphite, and the mixture is allowed to stand for 1–2 hours; the sand is then separated and washed.—F. SODN.

Ovens and driers suitable for use in the manufacture of tiles, bricks, pottery, and analogous ware, for annealing and for other purposes. C. Dressler, London. Eng. Pat. 18,821, Aug. 19, 1913.

In an oven or dryer of the type described in Eng. Pats. 18,114 of 1910, 8,228 and 23,863 of 1912, and 8505 of 1913 (this J., 1911, 1254; 1912, 752;

1913, 1094; and 1914, 540), a longitudinal wall or screen is fixed between each combustion chamber and the adjacent space containing the articles to be fired, forming, with the chamber, a separate air-heating passage and preventing or retarding the passage of radiant heat into the firing space, whilst forcing the heated air to circulate continuously over the screen, and down amongst the goods. The cooling zone is provided with a similar screen or screens, and an air passage is also provided between each combustion chamber or cooling conduit and the adjacent side wall of the oven, to allow air to flow under and on either side of the chamber or conduit. The walls of the combustion chamber are supported by rigid outward extensions, which may be connected at their outer sides to a longitudinal plate, so as to form a series of passages open only at the bottom and top; these prevent collapse of the walls in the event of softening by heat.—F. SODN.

Enamel composition. P. Eyer, Frankfort-on-the-Maine, Germany. U.S. Pat. 1,118,898, Nov. 24, 1914. Date of appl., Aug. 25, 1914.

A MIXTURE of boracite, 34.3 parts, sodium silicofluoride 8.8, quartz 10, felspar 33, soda 12, saltpetre 7.5, and cobalt oxide 0.3 part.—W. C. H.

Glass; Manufacture of illuminating—[for lamp globes, etc.]. G. A. Macbeth, Pittsburgh. Eng. Pat. 11,214, May 6, 1914. Under Int. Conv., May 9, 1913.

SEE U.S. Pat. 1,097,600 of 1914; this J., 1914, 693.

IX.—BUILDING MATERIALS.

Portland cement clinker; The compound, $8\text{CaO}, \text{Al}_2\text{O}_3, 2\text{SiO}_2$ (alite), the chief constituent of—E. Jänecke. Z. anorg. Chem., 1914, 89, 355–369.

THE mixture of composition, $8\text{CaO}, \text{Al}_2\text{O}_3, 2\text{SiO}_2$, was found to possess a maximum melting point, 1385°C , in the ternary system, $\text{CaO}-\text{Al}_2\text{O}_3-\text{SiO}_2$, and it therefore probably represents a definite compound. It has a sp. gr. 3.035, refractive index 1.63, and hardness 7 (Mohs' scale). The substance known as alite, which crystallises from cement clinker, exhibits all the properties of the above compound, and it is maintained, mainly on optical grounds, that the substances are identical.—G. F. M.

Cement; Standard specifications for—Year-Book of Amer. Soc. Testing Materials, 1914, 290–317.

General conditions. All cement shall be inspected and at least 12 days allowed for inspection and testing. A bag of cement shall contain 94 lb. of cement net; and each barrel of Portland cement shall contain 4 and of natural cement 3 bags of above net weight. Cement failing to meet the 7-day requirements may be held pending the results of the 28-day tests before rejection. All tests shall be made in accordance with the methods of the American Society of Civil Engineers (see this J., 1911, 490; 1912, 337). Acceptance or rejection shall be based on the following requirements:

Natural cement is defined as the finely-pulverised product resulting from the calcination of an argillaceous limestone at a temperature only sufficient to expel the carbonic acid gas. *Fineness*. Not more than 10% by weight to be left on a No. 100 and not more than 30% on a No. 200 sieve. *Time of setting*. At least 10 mins. for initial set and from 30 mins. to 3 hours for hard set. *Tensile strength*. The minimum requirements for briquettes 1 sq. in. in cross-section are given in the table: no retrogression in strength

must be shown within the periods specified. *Constancy of volume.* Pats of neat cement about 3 ins. diam., 0.5 in. thick at the centre, and tapering to a thin edge, shall be kept in moist air for 24 hours, and subsequently shall remain firm and hard and show no signs of distortion, checking, cracking, or disintegration when kept in air at normal temperature or in water at about 70° F. (21° C.) for at least 28 days.

Portland cement is defined as the finely pulverised product resulting from the calcination to incipient fusion of an intimate mixture of properly proportioned argillaceous and calcareous materials, and to which no addition greater than 3% has been made subsequent to calcination. *Specific gravity.* Not less than 3.10. If a sample fails to pass, a second test may be made on a sample ignited at a low red heat: the loss in weight on ignition shall not exceed 4%. *Fineness.* Not more than 8% on a No. 100 and not more than 25% on a No. 200 sieve. *Time of setting.* At least 30 mins. for initial set and from 1 to 10 hours for hard set. *Tensile strength.* See table: same conditions as for natural cement. *Constancy of volume.* Same as for natural cement, with the addition that a third pat is exposed in an atmosphere of steam, above boiling water, in a loosely closed vessel for 5 hours. *Sulphuric acid and magnesia.* Not more than 1.75% SO₃ and not more than 4% MgO.

Age.	Tensile strength of:			
	Natural cement.		Portland cement.	
	Neat.	Mixed with 3 parts of standard Ottawa sand.	Neat.	Mixed with 3 parts of standard Ottawa sand.
24 hours (in moist air)	lb. 75	lb. —	lb. 175	lb. —
7 days (1 in moist air, 6 in water)	150	50	500	200
28 days (1 in moist air, 27 in water)	250	125	600	275

—A. S.

Calcium sulphate; Hydration of the hemihydrate of —. P. Rohland. Z. anorg. Chem., 1914, 89, 352—354.

WHILE colloids, such as marshmallow or gum arabic, retard the velocity of hydration of calcium sulphate hemihydrate, many electrolytes either retard or accelerate it, according to their concentration. The hydration velocity stands in direct relationship to the solubility of the hemihydrate in the electrolyte; an increase in solubility, produced for example by the formation of a complex ion, as in the case of NaCl, KCl, KBr, NH₄Cl, MgCl₂, NaNO₃, etc., is accompanied by an increased rate of hydration of the calcium sulphate, since the less soluble dihydrate crystallises out, and more hemihydrate dissolves. On the other hand calcium salts, soluble sulphates, alcohol, etc., decrease the solubility and retard the hydration, unless, as in the case of the sulphates, for example, other effects, at greater concentrations, mask the effects of the mass action law. Sodium, potassium, and magnesium sulphates in small concentration retard hydration; at greater concentration they accelerate it, owing to complex ion formation. Similarly sulphuric acid forms the HSO₄⁻ ion and consequently accelerates the hydration.—G. F. M.

Corrosion of refractories by salts in coal. Searle. See IIa.

PATENTS.

Wood; Colouring and/or preserving —. F. T. Brooks, Cambridge. Eng. Pat. 24,595, Oct. 29, 1913.

THE wood is subjected to the action of *Chlorosplenium aeruginosum* (*Peziza aeruginosa*) or other fungus which is capable of colouring and/or preserving it from attack by putrefactive organisms. The sterilised wood may be introduced into a damp atmosphere, under sterile conditions, and should be inoculated with a pure culture of the fungus. —F. SODN.

Road-dust; Composition [from sulphite-cellulose waste lye] for laying —. C. Ellis, Larchmont, N.Y. U.S. Pat. 1,119,500, Dec. 1, 1914. Date of appl., Sept. 9, 1907. Renewed Oct. 20, 1914.

AN emulsion of concentrated waste sulphite liquor of 30° B. (sp. gr. 1.263), a hygroscopic softening agent, and a non-tarry petroleum oil, the last named not exceeding 25%.—W. C. H.

Preserved wood and method of making same. Buoyant articles and process of making same. Process of treating wood for buoyant articles and product thereof. R. A. Marr, Assignor to American Wood Encysting Co., Norfolk, Va. U.S. Pats. 1,121,643, 1,121,644, 1,121,645, and 1,121,646, Dec. 22, 1914. Dates of appl., Feb. 8, 1913, and Jan. 13, 1914.

SEE Eng. Pat. 2084 of 1914; this J., 1914, 867. The naphthalene may be replaced by rosin, and a dye may be added to the treating bath.

Drying kiln [for wood]. U.S. Pat. 1,119,595. See I.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

[Iron] blast-furnace; Heat balance of the —. S. Cornell. Met. and Chem. Eng., 1914, 12, 747—750.

DATA relating to the operation of a plant comprising six 600-ton blast-furnaces are given in full detail, conclusions as to distribution of heat being summarised as follows:—

	Steam blown furnace with dirty gas.	Steam blown furnace with cleaned gas.	Gas blown furnace with cleaned gas.
	%	%	%
Work of reduction, melting, and hot blast	43.17	43.65	43.65
Work of cooling furnace	1.26	1.25	1.25
Radiation loss	5.55	6.35	6.35
Gas leakage loss	5.82	5.77	5.77
Loss of heat in stoves	8.47	5.79	5.79
Loss of heat in boilers	18.20	18.09	—
Loss of heat in cooling gas	—	5.09	5.09
Heat in steam made	18.52	25.05	—
Steam used by furnace	18.38	18.22	—
Steam heat saleable	0.14	0.82	—
Heat in gas cleaned and used in blowers	—	—	5.00
Heat in gas cleaned and used in auxiliaries	—	—	2.73
Heat in gas to electric units	—	—	25.41
Conversion of available gas into electricity	—	—	4.75

The efficiencies of the steam and gas blowing engines were 7.66% and 21.49% respectively; and the stove efficiency 57.8% with cleaned, and 45.9% with dirty gas.—W. E. F. P.

Iron: Effects of pickling upon the corrosion of —
E. A. Richardson. Met. and Chem. Eng., 1914,
12, 759.

THE tests were made upon sheet irons of the same thickness and having the following compositions:—

Sample.	S	P	C	Mn	Cu
	%	%	%	%	%
A	0.020	0.003	0.01	0.052	0.048
B	0.050	0.117	0.10	0.319	0.268
C	0.045	0.094	0.10	0.406	trace
D	0.051	0.000	0.035	0.044	0.044

After annealing and cooling together under the same conditions, the test-pieces were cleaned by (1) grinding, (2) pickling in sulphuric acid, (3) pickling in sulphuric acid, followed by washing in water and dipping in dilute nitric acid, (4) pickling in sulphuric acid, followed by washing in water and dipping in a mixture of ammonia solution and hydrogen peroxide. The test-pieces were subsequently washed in water, dipped in alcohol, dried, exposed to the weather for 3 months, cleaned, etc., and re-weighed. The losses calculated to grains per sq. cm., were:—

Sample.	Method of cleaning test-pieces.			
	(1)	(2)	(3)	(4)
A	0.0597	0.0600	0.0441	0.0512
B	0.0372	0.0420	0.0233	0.0389
C	0.0652	0.0967	0.0446	0.0864
D	0.0651	0.0463	0.0437	0.0476

—W. E. F. P.

[Steel]. Influence of the duration of heating before quenching. A. Portevin. Bull. Soc. d'Encour., 1914, 121, 207—282. (See also this J., 1914, 791, 1011.)

PRELIMINARY experiments having indicated the time required for a piece of metal to attain at all points the temperature of a molten saline bath in which it was immersed, samples of steel (carbon steels with C 0.18 to 2.04%, chrome steels with Cr 8.82 to 29.34%, tungsten steels with W 5.30 to 15.03%, and molybdenum steels with Mo 1.19 and 2.53%) were maintained at different temperatures for varying definite periods, and then quenched. Mechanical tests on the quenched steels were found to be unsatisfactory, and the examination was accordingly confined to measuring the increase in the electrical resistance, and the change in hardness, as measured by the Brinell and Shore instruments, and to microscopic appearance. The results showed that the formation of solid solutions takes an appreciable time, the speed of transformation increasing with the temperature. The properties of quenched steels are sharply dependent on the duration of heating before quenching. Care must be taken in practice to ensure that the whole of a given article has actually attained the required temperature, but, on the other hand, as decarburisation of the surface tends to take place when steel is heated in molten saline baths, the period of immersion should not be unduly prolonged.—T. ST.

Steel; Improved method for the determination of nitrogen in —. L. E. Barton. J. Ind. Eng. Chem., 1914, 6, 1012—1013.

In the determination of nitrogen in steel (compare Braune, this J., 1904, 1114) the test solution and the standard for comparison sometimes develop

colours of different tones when treated with the Nessler reagent. To overcome this difficulty, dilute caustic soda solution is first distilled until the distillate gives no reaction with the Nessler reagent, then a solution of 5 grms. of the steel in 40 c.c. of hydrochloric acid free from ammonia is introduced into the retort, and distillation continued until 150 c.c. of distillate has been collected: 25 c.c. of a standard ammonium chloride solution and 150 c.c. of water free from ammonia are now introduced into the retort and a further 150 c.c. of distillate collected to serve as a standard. For the colour comparison 30 c.c. of the distillate from the steel solution (= 1 grm. of steel) are used. —A. S.

Steel rails; Specifications of United Steel Products Co. for standard —. Year-Book of Amer. Soc. Testing Materials, 1914, 390—403.

THE chemical composition of each heat of the steel from which the rails are rolled shall be within the following limits:—

Weight, lb. per yd.	45—60	61—70	71—80	81—100
Acid Bessemer steel				
C	0.30—0.40	0.35—0.45	0.35—0.45	0.40—0.50
Mn	0.70—1.00	0.70—1.00	0.70—1.00	0.80—1.10
Si (max.) ..	0.20	0.20	0.20	0.20
P (max.) ..	0.10	0.10	0.10	0.10
Basic open-hearth steel				
C	0.40—0.55	0.40—0.55	0.45—0.60	0.55—0.70
Mn	0.60—0.90	0.60—0.90	0.60—0.90	0.60—0.90
Si (max.) ..	0.20	0.20	0.20	0.20
P (max.) ..	0.04	0.04	0.04	0.04

In the case of the open-hearth steel the manufacturer shall furnish the chemical analysis of each heat of steel covering the elements specified in the table; whilst for acid Bessemer steel the carbon determination for each heat shall be furnished before the rails are shipped, and two analyses every 24 hours, one for each day and night shift respectively, covering the elements specified in the table. In both cases determinations shall be made on drillings taken from the ladle test ingot at not less than $\frac{1}{4}$ in. beneath the surface, and the manufacturer may be requested to furnish drillings for check analysis.

The specifications also cover details of manufacture and of mechanical tests.—A. S.

Manganese, nickel, iron, and cobalt, respectively, and carbon. (Researches in the field of high temperatures. V. to VIII.). O. Ruff, W. Bormann, and F. Kellig. Z. anorg. Chem., 1914, 88, 365—423. (See also this J., 1914, 647 and 1016.)

DETERMINATIONS were made of the solubility of carbon in the molten metals at definite temperatures, the boiling points of the pure and carbon-saturated metals under 30 mm. pressure, and the percentage of carbon in the vapour given off from the boiling carbon-saturated metals. Temperatures up to 1500° C. were measured by thermo-couple, and higher temperatures by a Wanner pyrometer. A carbon tube resistance furnace was used. In determining carbon-solubility 35—40 grms. of manganese and nickel and 25—30 grms. of iron and cobalt was melted in a graphite crucible, and then slowly heated to the desired temperature. This was maintained for about 30 minutes and the metal was then quenched. For the boiling point determination 25 grms. of metal in a graphite crucible was placed in the furnace which was then exhausted. The temperature was cautiously raised to avoid

spitting and the melt stirred with a carbon rod. The first uniform ebullition of the melt from the centre to the edge of the crucible was taken as the "initial boiling point." Initial boiling was quickly followed, as the temperature rose, by "severe spitting," when somewhat large pieces were thrown out of the crucible. In the case of iron, as the boiling point is about 2700° C. at 30 mm. pressure, and the carbon-solubility decreases above 2200° C., the melt was heated slowly to 1800° C. and then very quickly to 2700° C. The boiling points of the pure metals were determined in crucibles composed of zirconium dioxide with 1% of starch, 20 grms. of metal being taken. To determine the composition of the vapour yielded by the carbon-saturated metals, 0.5 to 2 grms. of metal in a clean graphite crucible was placed in the furnace, which was exhausted and slowly heated to just below the initial boiling point. After some time the temperature was raised, during about 30 minutes, to that of "severe spitting." The cooled residue was weighed and a determination of carbon or metal made. In the calculation of the carbon in the evolved vapour, the known percentage of carbon in the saturated metal was used in the case of manganese, but in the other cases the figures used were the determined total loss from metal and crucible and the metal remaining in the residue.

Manganese-carbon. Determinations of carbon-solubility were made at about 1300° C., 1400° C., and 1500° C., at atmospheric pressure in an atmosphere of hydrogen, the metal being cooled dry in a tube surrounded by ice. The carbon in the alloys was all combined. In determining the percentage of carbon a correction was made for the slag present derived from the guard tube of the thermo-junction. The results obtained were C 6.82% at 1312° C., 6.93% at 1427° C., and 7.05% at 1492° C. The mean values for the boiling points of manganese saturated with carbon under 30 mm. pressure were 1526° C. for "initial boiling point," and 1580° C. for "severe spitting." The upper end of the carbon-solubility line in the derived diagram was C 7.12% at 1525° C. The boiling point of pure manganese under 30 mm. pressure was found to be 1510° C. The vapour evolved from boiling manganese saturated with carbon at 30 mm. pressure contained C 1.94%. The residues contained graphite, and a completely volatilised melt left only flaky graphite. The solubility of carbon as such in the melts was extremely small, and the high percentage of carbon in saturated manganese at its boiling point under 30 mm. pressure is considered to indicate the existence of a carbide richer in carbon than Mn_2C .

Nickel-carbon. Cooling curves of Ni-C, carried out in an atmosphere of hydrogen and in magnesia crucibles, substantially confirmed Friedrich and Leroux's results (this J., 1910, 159). The melting point of pure nickel was found to be 1452° C., the eutectic temperature 1311° C., and the solid-solution and eutectic lines intersected at C 2.20%. The eutectic line is considered to terminate at 1300° C. and C 0.35%. The boiling point of carbon-saturated nickel under 30 mm. pressure was 2490° C., the carbon content of the alloy being 6.3%. The course of the carbon-solubility line from this point to the intersection of the eutectic line at C 2.2% has previously been determined by Ruff and Martin (this J., 1912, 285). It first falls to the point 2100° C. and C 6.4% (corresponding to Ni_3C) and then curves down to the eutectic point. The boiling point of pure nickel under 30 mm. pressure was found to be 2340° C. The vapour from carbon-saturated nickel boiling under 30 mm. pressure contained C 0.28±0.017%.

Iron-carbon. The carbon-solubility line for iron determined by Ruff and Goecke (this J., 1912, 233) was confirmed. The boiling point of

carbon-saturated iron under 36 mm. pressure was 2650° C., the carbon content being 7.4%. The determination of the boiling point of pure iron was uncertain but the most probable value was 2450±50° C. under 36 mm. pressure. The vapour from carbon-saturated iron boiling under 36 mm. pressure contained C 0.92±0.04%. The residue on complete volatilisation was not a carbide but only graphite. The significance of the changes in direction in the carbon-solubility line is discussed.

Cobalt-carbon. The carbon-solubility line runs from the point 1300° C. and C 2.4±0.2% (the intersection with the eutectic line) to 2415±10° C. and C 7.5% (the boiling point of carbon-saturated cobalt under 30 mm. pressure). The curve shows a change of direction at the point corresponding to the composition Co_3C . The combined carbon in the quenched alloys varied between 0.1 and 0.3%. The boiling point of pure cobalt under 30 mm. pressure is 2375±40° C. The carbon content of the vapour yielded by carbon-saturated cobalt boiling under 30 mm. pressure is 2.0±0.6%.

—T. ST.

Boron steels. G. Hanneseni. Z. anorg. Chem., 1914, 89, 257—278.

ALLOYS containing up to 8.5% B were examined. By slow cooling three types of crystals were obtained. With 0—1.38% B, mixed crystals of δ -iron separated first, from 1.38—4% mixed crystals of γ -iron, and from 4—8.5% B, Fe_3B , which was found to be the lowest boride of iron. It melts at 1351° C., and forms needle-shaped crystals of rhombic section. The temperatures of the change of γ into β -iron, and of β into α -iron are both lowered by the presence of boron. By rapid cooling of steels containing from 0.375—2% B a martensitic structure was obtained, but in no case was an austenitic structure produced, since γ -iron dissolves much less boron than carbon. All the boron steels and also Fe_3B , are magnetic. Quenched and slowly cooled steels containing 0.125—4% B both showed a hardness 5 to 6 on Mohs' scale, except slowly cooled steels with 0.25—1% B, which contained boropearlite, and, in contrast to carbon pearlites, were harder than the other steels. When Fe_3B formed the chief structural element (that is, with more than 4% B) the hardness rapidly increased, becoming, with 8% B, equal to that of corundum.—G. F. M.

Platinum; Analysis of —. F. Mylius and A. Mazzucchelli. Z. anorg. Chem., 1914, 89, 1—38. (See also Mylius and Foerster, this J., 1892, 690.)

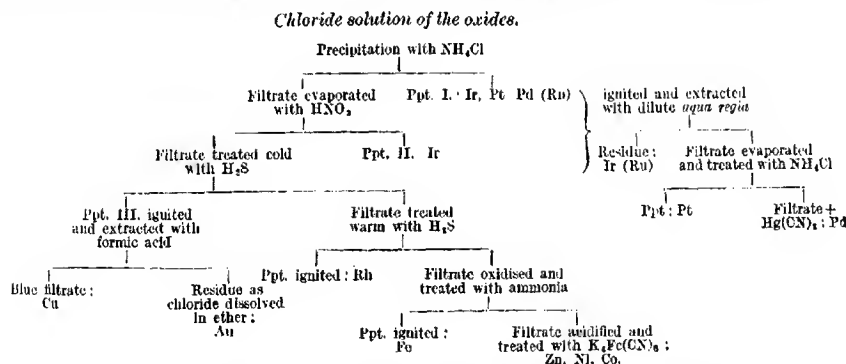
SCHEMES are given for the qualitative and quantitative examination of nominally pure and commercial platinum, based on a critical review of known methods and the results of special experimental work. The qualitative examination permits of the detection of 1 mgrm. each of Pd, Pt, Rh, Ru, Ir, Au, Ag, Cu, and Fe in a chloride solution.

In the quantitative analysis of commercial platinum the traces of ruthenium present may be disregarded. The approximate purity of the metal is first ascertained by dissolving 0.1 grm. in *aqua regia*, evaporating with sodium chloride, dissolving the residue in 10 c.c. of water, heating with about 0.02 grm. of sodium carbonate, treating the cooled solution with 1 or 2 drops of sodium hypochlorite or hypobromite solution, and again warming. If the solution retains its orange yellow colour and no precipitate is formed, the metal may be regarded as "nominally pure" platinum, but if the colour darkens and a dark blue precipitate gradually forms, the metal is classed as impure or "commercial" platinum.

Group precipitation.	Secondary separations.
I. The solution is evaporated nearly to dryness, diluted with 2 c.c. of water, and filtered. Precipitate: AgCl.	(6.) The precipitate is treated on the filter with ammonia, and HNO ₃ added to the filtrate. White precipitate indicates Ag. The dark residue on the filter is transferred to (5).
II. The filtrate from I is saturated with NH ₄ Cl, filtered after 1 hour, and the precipitate washed with NH ₄ Cl solution. Precipitate: double chlorides of Pt, Ir, Ru.	(5.) The precipitate from II., together with residues from (1) to (6), is heated in hydrogen, ultimately to incandescence, the reduced metal treated with diluted <i>aqua regia</i> , and the solution evaporated, Pt being detected by formation of the yellow double ammonium chloride. The insoluble residue is ignited with 0.3 grm. NaNO ₂ in a gold or silver spoon. Ru dissolves in the melt, colouring it yellow, whilst Ir remains as a blue residue.
III. The filtrate from II. is evaporated to dryness with 3 c.c. of dilute HNO ₃ , the residue treated with dilute HNO ₃ so as to obtain a solution nearly saturated with NH ₄ Cl, filtered, and the residue washed with a very small quantity of a solution of HNO ₃ +NH ₄ Cl. Precipitate: double salts of Pd, Ir, and Ru.	(4.) The precipitate from III. is evaporated with HCl, the residue treated with 3 c.c. of water, and the solution saturated cold with H ₂ S. The sulphide precipitate is evaporated with <i>aqua regia</i> , and the solution of the evaporation residue tested for Pd with Hg(CN) ₂ . Any residues containing Ir are transferred to (5).
IV. The filtrate from III. is evaporated to dryness with dilute HCl, the residue dissolved in 5 c.c. of water with addition of 1 drop of dilute HCl, and the solution rapidly saturated with H ₂ S at about 18° C. The black precipitate is filtered off after 10 mins., and washed with water. Precipitate: sulphides of Au and Cu.	(3.) The sulphide precipitate is dissolved in dilute <i>aqua regia</i> , the solution evaporated, the residue dissolved in dilute HCl, and the solution extracted with ether. If the ether layer is coloured yellow and gives a precipitate with SO ₂ , Au is indicated. The aqueous layer is treated with H ₂ S, the precipitate filtered off, washed, ignited, and treated with dilute HNO ₃ . Cu is detected by a blue coloration of the solution on adding excess of ammonia. Any residue insoluble in HNO ₃ is transferred to (5).
V. The filtrate (6–8 c.c.) from IV. is warmed and treated with H ₂ S for 1 hour, the excess of H ₂ S boiled off, and the brown precipitate filtered off and washed with water. Precipitate: rhodium sulphide.	(2.) The sulphide precipitate is dissolved from the filter in hot dilute <i>aqua regia</i> , the solution evaporated, and the residue warmed with concentrated HCl. A rose-red solution which gives a yellow precipitate on warming with a 1% solution of ethylmercaptan indicates Rh. The filtrate may contain traces of Ir.
VI. The filtrate from V. is boiled, oxidised with HNO ₃ , treated with ammonia, and the precipitate filtered off. The evaporation residue from the filtrate should consist only of ammonium salts and be completely volatilised on heating.	(1.) The precipitate from VI. is ignited, dissolved in HCl, and Fe detected by the Prussian blue reaction. Any insoluble residue is transferred to (5).

Commercial platinum. 10 grms. is dissolved in *aqua regia* in a flask of quartz glass and the solution evaporated with 6 grms. of sodium chloride. The residue is evaporated several times with water,

platinum-sodium chloride. The precipitate, consisting mainly of the oxides of the foreign metals, together with some platinum, is analysed according to the following scheme:—



then heated for 1 hour at 120° C., treated with about 100 c.c. of water, and the solution filtered. The small quantity of residue may contain gold, silver, iron salts, silver chloride, etc., and is analysed separately. The solution is diluted to 100 c.c., made faintly alkaline with 0.8 grm. of sodium bicarbonate, heated to boiling, cooled, and again heated with a solution of 0.8 grm. of sodium carbonate in 20 c.c. of saturated bromine water; the solution should remain faintly alkaline. When a test portion of the yellow solution no longer gives a dark coloration with the hypobromite solution, the whole is filtered (after addition of alcohol, if necessary, to coagulate the precipitate), and the black precipitate washed with water, the filtrate being heated with alcohol and again filtered through a separate filter. The solution contains nearly the whole of the platinum as

Nominally pure platinum. 50 grms. is converted as described above, into the platinum-sodium chloride, which is recrystallised several times from a 1% solution of sodium carbonate. The mother liquors, together with the solution obtained by treating the small quantity of insoluble matter left from the first operation, are evaporated first with *aqua regia*, then with hydrochloric acid, and the residue heated to 150° C., treated with water, and filtered. The solution may be analysed as described under commercial platinum, or it may be faintly acidified, treated with ammonium chloride, and filtered. The precipitate consists of platinum-ammonium chloride contaminated by a little iridium. The filtrate is treated warm with hydrogen sulphide for several hours, the sulphides ignited and the residue dissolved in *aqua regia* (the precipitate is dissolved directly in *aqua regia* if

lead or other volatile metals are present). The filtered solution is analysed according to the scheme given above. All precipitates of platinum ammonium chloride must be treated for the separation of iridium, which is effected by reduction with hydrazine in strong hydrochloric acid solution, the platinum being precipitated and the iridium left dissolved.

The Ir content of commercial platinum can be rapidly estimated by dissolving 0.01 gram in *aqua regia*, evaporating, dissolving the residue in concentrated hydrochloric acid to 100 c.c., and comparing the colour with that of a standard solution of Pt and Ir in concentrated hydrochloric acid.

In the following table are given analyses of the impurities contained in three platinum muffles: I. and II. behaved well in use, but III. was strongly corroded, with formation of soot:—

	I.	II.	III.
Ir	2.2	2.23	1.01
Pd	?	0.13	0.15
Au	0.30	0.3	—
Rh	trace	trace	0.15
Cu	0.13	0.18	0.09
Pt	0.13	0.12	0.11
Ag	—	—	trace
Ni	trace	trace	trace
Undetermined	—	—	0.1
Total	3.0	2.96	2.95

—A. S.

[Ore] pulp constants. G. H. Clevenger, H. W. Young, and T. N. Turner. Eng. and Min. J., 1914, 1079—1094.

In calculating the percentage of dry slime in wet pulp, the assumption that the specific gravity of the solution is unity leads to errors which increase as the percentage of solids in the pulp decreases. Tables have been constructed which give the results of such calculations when the specific gravity is taken as 1, and the correction to be made for the difference between 1 and the true specific gravity of the solution. The tables are given for specific gravities of dry slime of from 2.50 to 3.00 and for wet pulps of from 1010 to 1500 grms. per litre. Tables are also given showing the pounds of dry slime in a cubic foot of pulp, the number of cubic foot of wet pulp necessary to produce one ton of dry slime, the dilution ratios of solution to dry slime, and the number of cubic feet for each foot of depth of cylindrical tanks.—W. F. B.

Copper smelting industries of Canada. A. W. G. Wilson. Report No. 209, Canada Dept. of Mines, Mines Branch, Ottawa.

The development of the copper smelting industries of Canada is reviewed and the plants now in operation are described and illustrated. The report covers 184 pages, contains 42 tables, and is illustrated by 43 plates, 39 figures, and 4 maps.

Copper-zinc alloys; Binary — and ternary copper-zinc-lead alloys. N. Parravano. Gaz. Chim. Ital., 1914, 44, II., 475—502.

THE equilibrium diagram of Cu-Zn alloys based on the author's results is similar to that of Shepherd (this J., 1905, 241), except that the decomposition of β into $\alpha + \gamma$ (see Carpenter and Edwards, this J., 1911, 133; 1912, 133, 926) is taken into account, and the limits of the horizontals are fixed. The limiting saturation of α at 905° C. is 39.5% Zn. The horizontal at 838° C. corresponds to the formation of γ , the limiting saturation of β being 57% Zn; that at 700° (formation of δ) extends

to 29.5% Cu, with the maximum effect at 27.5% Cu; that at 595° (formation of ϵ) extends to 24% Cu, with the maximum effect at 17.5% Cu; that at 545° (decomposition of δ into $\gamma + \epsilon$) extends from 30 to 19% Cu, the eutectoid decomposition point being at 26% Cu; and that at 425° C. (formation of η) extends from 13 to 3% Cu. The thermal effect at 470° C., discovered by Roberts-Austen (see Carpenter and Edwards, *loc. cit.*) was observed in alloys containing 63—39% Cu. Examination of ternary Cu-Zn-Pb alloys showed that lead does not dissolve in the solid state, in the α or γ Cu-Zn solid solutions, and that in lead brasses it is simply admixed mechanically with the Cu-Zn alloy.—A. S.

Manganese supplies. Engineering, Jan. 1, 1915.

THE total production of manganese ore throughout the world ranges from 2,000,000 to 2,250,000 tons, of which about 40% come from Russia; the output is distributed as follows according to the most recent figures:—Russia, 987,724 tons; India, 674,315; Brazil, 163,506; Germany, 75,787; Austria, 17,717; Spain, 16,678; Turkey, 14,123; Japan, 10,955; Greece, 10,581; Hungary, 10,410 tons. The productions of other countries are smaller. Exporting countries are Russia, British India, Brazil, Germany, Belgium and France. One of the first effects of the war was the action of Russia, which placed an embargo on the export of manganese ore, but early in October this was raised. Great Britain exports large quantities of ferro-manganese to the United States; in fact, American steel-makers depend mainly on this country for their supply of this alloy. There are said to be ample supplies of ferromanganese in Germany. An embargo has been placed on shipments of manganese ores from British India to the United States, and it is practically impossible for Russia to export her output. That will tend to develop the Brazilian output. Deposits of manganese iron ores are being opened up in California, which may render the United States independent of Indian and Russian supplies. The production of manganese ore in Brazil has assumed an importance never known before; British and American steel manufacturers have been taking about 65,000 tons annually, and arrangements are now being made in the States for the importation of a much larger quantity. The Brazilian ore is of exceptional quality, principally pyrolusite and rhodonite. There are vast supplies; in the vicinity of Corumbó there are more than 100,000,000 tons of ore.

Our imports of manganese ore during recent years have been:—1909, 330,500 tons; 1910, 482,200; 1911, 358,910; 1912, 387,730; 1913, 601,170; 1914 (first 11 months), 446,200 tons.

We import manganese ore from Russia, Portuguese possessions in India, Spain, Brazil, British India, and in very small quantities from Germany. From Russia imports were 137,650 tons in 1909, 163,630 tons in 1912, and 241,890 tons in 1913.

From Portuguese India our imports have recently increased to 24,710 tons. Imports from Brazil and Spain are decreasing. Imports from British India last year were 308,790 tons, and in 1909, 109,480 tons. Our exports of manganese ore in 1914 were only 9960 tons. Exports go mainly to Belgium, and, to a very limited extent, to the United States.

Our imports of manganese iron ore had risen to 211,040 tons in 1913. None of this was re-exported; of ore produced in this country only 34 tons was exported last year; during 1910 the quantity reached 786 tons. Our imports come from Spain and Greece; those from Spain are increasing rapidly, whilst those from British India have ceased lately. Our exports of the ore produced in this country for the first 11 months of

1914 were 1498 tons, compared with 27 tons for the corresponding period of 1913.

In addition to manganiferous ores, there are several other sources of supply, such as manganiferous iron and silver, also the manganiferous residuum from zinc-roasting. In the United States there are many deposits, but only in a few places do they occur in sufficient quantity to be of high commercial value. Deposits occur in the New England, Appalachian, and Piedmont regions in the Eastern United States, and to a limited extent in Central Western California. Manganiferous iron and silver ores are also widely distributed; but manganese mining is not a very important industry in the States, owing to the discontinuous and somewhat scattered nature of many of the deposits.

Manganese alloys capable of magnetisation; Studies of— F. Heusler. *Z. anorg. Chem.*, 1914, 88, 185–188.

Of the alloys of 30% manganese-copper with tin, that containing 39.5% Sn, corresponding with the formula, SnMnCu_2 , showed the maximum magnetisation; with 15% manganese-copper a similar maximum was given by an alloy, $\text{Sn}_2\text{Cu}_3\text{Mn}$; so that in each case the sum of Mn and Cu atoms is three times that of the Sn atoms. These alloys are regarded as derived from the intermetallic compound, SnCu_3 . Similar relationships hold for AlCu_3 .—J. R.

Babbitt metal; [Determination of] copper [and lead] in— E. W. Hagmaier. *Met. and Chem. Eng.*, 1914, 12, 753.

To 1 gram of the alloy, 15 c.c. of hot water and sufficient tartaric acid are added to keep all the tin and antimony in solution, then 5 c.c. of nitric acid, and the liquid boiled until solution is complete. The solution is heated with 5 c.c. of sulphuric acid until nitrous fumes cease to be evolved (avoiding charring), cooled, 50 c.c. of water is added and the lead sulphate settled and filtered off. The filtrate is diluted to 400–500 c.c., 1–2 c.c. of hydrochloric acid added, and the copper precipitated upon a strip of pure aluminium and determined as usual.—W. E. F. P.

Lead oxide-copper oxide; The system— J. C. J. Cunningham. *Z. anorg. Chem.*, 1914, 89, 48–52.

In the cupellation of alloys, copper when present together with lead is oxidised and absorbed by the cupel, although copper oxide alone is not absorbed. Examination of mixtures of lead oxide with up to 30% of copper oxide showed that no compounds of the two oxides are formed. Mixtures containing more than 30% CuO attacked the platinum containing vessel. Lead oxide melts at 875° C. and the melting point is lowered by addition of copper oxide. The two oxides form an eutectic mixture melting at about 698° C.—A. S.

Zinc blende and lead sulphide; Rate of solution of— in dilute sulphuric acid. F. Rosenkränzer. *Z. anorg. Chem.*, 1914, 88, 452. (See this J., 1914, 752.)

The relative susceptibilities of different ores to the attack of dilute sulphuric acid are more correctly expressed in terms of equal volumes of the powdered ores than of equal weights, as was done by the author in his investigation (this J., 1914, 752). The four zinc blendes did not vary much in specific gravity, but when the heavier galena is included in the common scale the figure for the latter becomes almost doubled.

—T. St.

Metals; Solutions of—in boiling mercury. Ebullioscopic experiments. E. Beckmann and O. Liesche. *Z. anorg. Chem.*, 1914, 89, 171–190.

THE results of ebullioscopic experiments on solutions of Na, K, Ca, Mg, Tl, Cd, Zn, Sn, Pb, Bi, Ag, and Au are tabulated. The ebullioscopic constant of pure mercury was found to be 114°0. With solutions of the alkali and alkaline-earth metals and thallium in mercury, the constant was too high and increased with the concentration of the dissolved metal, indicating the formation of amalgams. In some cases the deviation from the normal value was sufficiently great to indicate the approximate composition of the amalgams, viz., NaHg_2 to NaHg_4 , KHg_2 to KHg_4 , CaHg_{10} . The heavy and precious metals appear to dissolve in the mercury in the monatomic form, but a distinct tendency to association was observed with Sn, Pb, and Bi.—A. S.

Mineral production of the United Kingdom in 1913. Board of Trade J., Jan. 14, 1915.

THE following table shows the quantity and value (definitive figures) of the minerals produced in the United Kingdom in 1913, as compared with 1912:—

Description of Mineral.	1912.		1913.	
	Quantity.	Value at the Mines and Quarries.	Quantity.	Value at the Mines and Quarries.
Alum shale....	Tons.	£	Tons.	£
Arsenical pyrites	11,258	1,155	8,741	874
Arsenic	2,450	2,040	35	29
Barium (compound)	2,194	17,901	1,695	16,616
Bauxites.....	45,377	39,430	50,045	42,138
Bog ore	5,790	1,414	6,055	1,583
Chalk	3,340	835	3,835	959
Chert, flint, etc.	4,235,412	190,799	4,858,126	213,479
Clay and shale.	74,718	13,426	74,858	12,781
Coal	12,808,050	1,033,736	13,859,821	1,778,071
Copper ore	290,416,338	117,921,123	287,430,473	145,535,069
Copper precipitate	1,787	12,985	2,669	21,138
Diatomite	146	6,404	163	5,891
Fluorspar	63	82	154	308
Gold ore	47,246	17,263	53,663	14,955
Gravel and sand	170	4,784	4	434
Gypsum	2,191,451	167,640	2,409,152	184,818
Igneous rocks.	285,291	110,591	285,338	90,450
Iron ore	6,638,215	1,210,418	7,098,493	1,396,022
Iron pyrites ..	13,790,391*	3,763,837	15,997,323*	4,543,558
Lead ore	10,522	4,324	11,427	5,988
Lignite	25,409	295,907	24,232	293,325
Limestone (other than chalk) ..	62	31	81	40
Manganese ore.	11,500,660	1,207,022	12,740,664	1,369,168
Mica	4,170	3,371	5,393	4,072
Ochre, amber, etc.	29,962	11,317	32,936	12,734
Oil shale	13,947	13,801	15,135	14,460
Salt	3,181,826	755,730	3,280,143	822,394
Sandstone	2,122,250	577,473	2,247,758	908,969
Slate	3,832,567	1,122,391	3,977,303	1,143,431
Soapstone	383,422	972,022	370,756	928,730
Sulphate of strontia	8	2	40	30
Tin ore (dressed)	19,370	15,029	18,425	14,287
Uranium ore ..	8,166	1,012,290	8,355	960,134
Wolfram ore ..	42	Not stated	95	Not stated
Zinc ore	193	18,873†	182	17,483†
	17,704	87,867	17,294	69,502
Total value ..	—	131,220,853	—	160,112,607

* Exclusive of 431 tons in 1912 and 520 tons in 1913 of micaceous iron ore used for paint, and placed under the heading of "Ochre, amber, etc."

† Value of 192† tons only for 1912 and of about 180 tons only for 1913.

The increase in the total value of the minerals raised during the year is mainly accounted for by the increased production of coal and its enhanced value, the average price of coal being 10s. 1.52d. per ton in 1913, as compared with

9s. 0-68d. in 1912. The quantity of coal exported, exclusive of coke and manufactured fuel and of coal shipped for the use of steamers engaged in foreign trade, was 73,400,118 tons. France received over 12½ million tons, Italy over 9½ million tons, Germany nearly 9 million tons, Russia nearly 6 million tons, Sweden over 4½ million tons, Argentina over 3½ million tons, Spain over 3½ million tons, Egypt over 3 million tons, Denmark over 3 million tons, and Norway and the Netherlands each over 2 million tons. Adding the 3,906,436 tons exported in the form of coke and manufactured fuel, and the 21,031,550 tons shipped for the use of British and foreign steamers engaged in foreign trade, the total quantity of coal which left the country was 98,338,104 tons as against 85,842,905 tons in 1912. The amount of coal remaining for home consumption was 189,092,369 tons, or 4-108 tons per head of the population. 39,580,489 tons were used in the manufacture of coke and briquettes, and 21,223,607 tons in the blast furnaces for the manufacture of pig iron, as against 35,322,147 tons and 17,997,854 tons, respectively, in the previous year.

The output of iron ore yielded 5,138,958 tons of iron, or more than one-half of the total quantity of pig iron made in this country.

Production of metals and minerals in the United States. Eng. and Min. J., Jan. 9, 1915.

Metals.

Metal.	Unit.	1913.	1914.
Aluminium	lb.	(g) 49,601,500	(h) 45,000,000
Copper (a)	lb.	1,225,735,834	1,135,730,818
Manganese	long tons	229,834	172,514
Gold (b)	fl.	88,884,400	92,823,500
Iron	long tons	30,736,477	23,083,580
Lead (c)	short tons	433,476	533,373
Nickel (e)	lb.	47,124,330	(e) 30,087,064
Quicksilver	flasks	(h) 20,000	16,300
Silver (b)	tray oz.	66,801,500	67,923,700
Zinc (d)	short tons	358,282	360,689

(a) Production from ore originating in the United States. (b) The statistics for 1912 and 1913 are the final and those for 1914 are the preliminary statistics reported jointly by the directors of the Mint and the U.S. Geological Survey. (c) Production of refined lead from ore and scrap originating in the United States; antimonial lead is included. (d) Total production of smelters, except those treating dross and junk exclusively; includes spelter derived from imported ore. (e) Imports; for 1914, first 10 months only. This nickel is refined in the United States for the production of metal, oxide, and salts. (f) As reported by the Metallgesellschaft Frankfurt am Main. (h) Estimated.

Mineral and Chemical Substances.

Substance.	Unit.	1913.	1914.
Arsenic	lb.	4,624,140	8,651,940
Coal, anth. (a)	short tons	91,620,825	91,552,187
Coal, bitu. (a)	short tons	478,688,867	419,547,509
Coke (a)	short tons	45,953,808	34,418,933
Copper sulphate	lb.	54,330,000	31,776,670
Iron ore	long tons	61,847,116	42,911,897

(a) The coal and coke statistics are the estimates of Coal Age.

Gravimetric determination of zinc. Treadwell. See XXIII.

PATENTS.

Iron, pure iron alloys, and phosphorised pure iron and iron alloys; Production of pure —. R. B. Carnahan, jun., Middletown, Ohio, U.S.A. Eng. Pat. 28,440, Dec. 9, 1913. (See also Eng. Pats. 27,201 of 1909 and 5015 of 1911; this J., 1910, 960, 219; 1912, 77.)

Pig iron is overblown in a highly basic Bessemer furnace until the Si, S, P, C, and Mn together

do not exceed about 0-14 %; the sulphur should be below 0-03 %. The metal is deoxidised and degasified by means of aluminium so that not more than 0-05 % of oxygen remains. Other metals may be added to the purified iron, and the phosphorus may be raised to 0-05—0-5 % by the addition of ferro-phosphorus, preferably in the ladle during tapping. The resulting ingot is free from slag and crystalline, and suitable for rolling or forging. A phosphorised Ni-Fe alloy produced in the way described is highly resistant to corrosion.—T. ST.

Armour plates; Cementation process for —. E. C. Marks, London. From Soc. Anon. Italiana Gio. Ansaldo & Co. Eng. Pat. 18,386, Aug. 7, 1914.

THE plates are arranged in furnaces with packing pieces so that boxes open at top and bottom are formed. Solid cementing agents are introduced at the top, and gaseous cementing agents at the bottom.—O. E. M.

Iron and steel; Hardening of —. E. Sweet, Binghamton, N.Y., Assignor to J. W. Boyd, Denver, Colo. U.S. Pat. 1,121,572, Dec. 15, 1914. Date of appl., Oct. 6, 1911.

THE iron is dipped into a mixture of molten potassium cyanide and charcoal, and quenched in oil.—O. E. M.

Metals [steel]; Cleaning compound for —. G. D. Feidt, Assignor to American Chemical Paint Co., Philadelphia, Pa. U.S. Pat. 1,119,781, Dec. 1, 1914. Date of appl., Sept. 14, 1914.

A CLEANING agent for steel consisting of a mixture of orthophosphoric acid, alcohol, and carbon tetrachloride.—T. ST.

Ore separators. A. M. Plumb, Denver, Colo., U.S.A. Eng. Pat. 24,194, Oct. 25, 1913.

THE separator is of the jig type, the action being produced by intermittent impulses of air applied to the entire bottom of the separating chamber. A longitudinal partition divides the matter in the separating chamber into two columns which communicate near the bottom of the chamber. Discharge openings are arranged so that the weights of the columns are equal. The heavier ore particles work down and under the partition and are subsequently discharged at the further side.—T. ST.

Ores; Concentrating —. H. Fairbrother, London. From Deister Machine Co., Fort Wayne, Ind., U.S.A. Eng. Pat. 3442, Feb. 10, 1914.

A VIBRATING concentrating table has two or more plateaus extending across it at right angles to the direction of vibration, the heights of the various plateaus being different and increasing in the direction of flow of the values. The highest plateau extends to the mineral discharge edge. The steps from lower to higher surfaces are bevelled to reduce retardation of the flow of concentrates. Riffles extend across the table in a direction transverse to the direction of flow of the pulp, the riffles tapering from points in the rear of the first plateau so that an accumulation of gangue at the step is prevented. One or more riffles substantially higher than the others are provided to cause the formation of pools, and so insure proper distribution of pulp across the surface of the table. These higher riffles also taper, but they preferably slightly overlap the bevelled step up to the first plateau.—T. ST.

Ore; Apparatus (tube-mill) for crushing—or the like. W. B. Easton, Chicago, U.S.A. Eng. Pat. 14,234, June 12, 1914.

NEAR the discharge end of the tube is a transverse perforated plate forming a chamber in which vanes are mounted to raise and discharge the water and crushed ore through the hollow axial trunnion. The operative parts of the vanes are controlled from the outside so that the rate of discharge can be regulated.—T. St.

Fusible substances [metals]; Process of and apparatus for applying coatings or deposits of—to surfaces. E. Mori, Zürich, Switzerland. Eng. Pat. 25,132, Nov. 4, 1913. Under Int. Conv., Nov. 5, 1912. (See also Eng. Pat. 28,001 of 1912; this J., 1913, 792.)

THE material to be deposited is fed automatically in rod or other suitable form to the nozzle of the burner and sprayer at a rate depending on the pressure of the air blast required for spraying. In one form of apparatus the compressed air is passed through a turbine which actuates the feeding device through gearing. A single valve controls the supplies of compressed air and heating gases, and the several operations—feed, melting, spraying and projection of the fusible substance—are thus all effected automatically at the same proportional rate.—T. St.

Metals; Process of treating—for the purpose of rendering them proof against oxidation, rusting or the like. J. A. McLarty, Toronto, Canada. Eng. Pat. 27,141, Nov. 25, 1913. Under Int. Conv., March 21, 1913. Addition to Eng. Pat. 25,013 of 1913.

THE metal (iron, steel, bronze, brass, etc.) is subjected in a closed vessel to the action of the gases, etc., produced by heating a mixture of sawdust, crude petroleum, and water. The temperature of the metal is kept very much below red heat. The oxygen in the vessel may be removed by igniting the vapours before the vessel is closed. The time of exposure for small articles is about 4 to 5 hours, and the pressure inside the vessel may be either above or below atmospheric.—T. St.

Slags; Generation of steam from the heat contained in—. C. Vautin, London. Eng. Pat. 28,015, Dec. 5, 1913, and 2393, Jan. 29, 1914.

MOLTEN slag is brought into contact with water in a closed vessel and the granulated slag continuously removed. The steam evolved contains hydrogen sulphide, sulphur, sulphur dioxide, fine particles of slag, etc., and hence has a deleterious action on turbine blades (cf. Eng. Pat. 3623 of 1909; this J., 1909, 987). It is therefore passed through a heat exchanger where clean steam is generated. The condensed primary steam is returned to the primary generator, suitable valves being placed in the return pipe for the escape of uncondensed gases and for running the condensed water to waste when overcharged with impurities. Eng. Pat. 17,564 of 1888 is referred to.—T. St.

Tin andterne plates; Manufacture of—and apparatus therefor. R. B. Thomas, London, H. S. Thomas, Llandaff, and W. R. Davies, Whitchurch, Glamorgan. Eng. Pat. 28,450, Dec. 9, 1913.

THE plates are picked up singly by a sucker on an arm, and fed singly to rollers which convey them successively through pickling, swilling, tinning, greasing, and dusting or branning apparatus. Motion through the tin pot is rapid relative to that through the grease pot.—O. E. M.

Furnaces; Electric induction—. J. Hårdén, Luton. Eng. Pat. 570, Jan. 8, 1914.

To check the leakage from the primary field following on the mutual induction between the primary and induced fields, the primary winding is made to surround the portion of the magnetic core actually encircled by the bath, and also to spread in planes above and below the bath; also the ampère-turns are increased in number in proportion as the magnetic leakage field tends to increase. The tendency of the bath to form a surface sloping downwards towards the centre is thus largely eliminated, and the rolling motion is suppressed. The primary winding, and also the bath, may be subdivided, the subdivisions of the bath encircling separate limbs of the magnetic frame, but uniting at one part. With a polyphase current, a separate hearth and a separate magnetic core and winding are provided for each phase, the hearths uniting at one part.—T. St.

Annealing furnace. C. Kugel, Brunswick, Germany. U.S. Pat. 1,118,868, Nov. 24, 1914. Date of appl., Sept. 20, 1913.

THE furnace consists of a charging and heating chamber situated beneath a cooling chamber open at the bottom. The latter has a rotary cover, in which are connections by means of which frames containing the metal may be moved from one chamber to another.—T. St.

Roasting-furnace shaft. H. H. Stout, Assignor to General Chemical Co., New York. U.S. Pat. 1,119,325, Dec. 1, 1914. Date of appl., Apr. 25, 1913.

INNER and outer tubular walls, spaced from each other, are apertured and joined at the apertures by tubular connections which are attached to one of the walls in such a manner that the inner and outer walls can move slightly longitudinally in relation to each other.—T. St.

Furnace; Metallurgical—. U. Wedge, Ardmore, Pa. U.S. Pat. 1,119,483, Dec. 1, 1914. Date of appl., Feb. 28, 1914.

A SERIES of superposed hearths, alternately fixed and rotating, is contained in a cylindrical casing. Rabblers are fixed to the under surfaces of each hearth for acting on the material on the hearth below. The casing of the furnace has inlet and outlet flues communicating with the interior.—T. St.

Roasting and smelting furnace; Combined—. W. R. Heslewood, Assignor to Hydro Vacuum Smelting Co., Oakland, Cal. U.S. Pat. 1,121,559, Dec. 15, 1914. Date of appl., March 9, 1914.

THE hot gases from a smelting furnace rise into a superimposed roasting furnace, from which the ore is allowed to fall as required into the smelting furnace.—O. E. M.

Crucible-furnace. G. Mellen, Mount Vernon, N.Y. U.S. Pat. 1,120,732, Dec. 15, 1914. Date of appl., Feb. 23, 1911.

THE crucible is surrounded on its sides and bottom by a closely fitting gas-tight shell, and this in turn by refractory material. The lower parts of this combination are surrounded by an inclosed combustion chamber. The shell has a screwed-on cover, provided with handles and with a conduit for introducing and withdrawing gas, and the crucible has a lid spaced from the cover.—T. St.

Ores, intermediate products, and other metalliferous materials (blends); Process of roasting—R. von Zelewski, Belgium. U.S. Pat. 1,097,500, May 19, 1914. Date of appl., Feb. 18, 1913.

BRIQUETTED sulphide ores, etc., are piled in chequerwork form in an enclosure, and hot products of combustion and air under pressure are supplied to heat and ignite the liberated gases. When the gases are ignited the supply of the products of combustion is stopped, but that of air is continued until the briquettes reach a slag condition.—T. St.

Ores; Process for treating—W. A. Thacher, Lake City, Colo., Assignor to The Acid Process Co. U.S. Pat. 1,119,473, Dec. 1, 1914. Date of appl., Oct. 30, 1911. Renewed Feb. 16, 1914.

SULPHIDE ores are mixed with acid in a closed vessel and a stream of compressed air is passed through the mixture. A portion of the charge is sprayed in the path of the acid fumes and gases rising from the charge, and any acid gases which pass beyond the spray are collected in an absorbing liquid.—T. St.

Alloy; Pyrophoric—A. Kratky, Vienna, Assignor to H. B. Smith, Brooklyn, N.Y. U.S. Pat. 1,118,138, Nov. 24, 1914. Date of appl., April 26, 1913.

A PYROPHORIC alloy containing approximately 84% of a metal of the cerium group, 8% Mg, and 8% Zn.—T. St.

Aluminium alloy and method of producing the same. W. A. McAdams, Bay Shore, N.Y. U.S. Pat. 1,121,267, Dec. 15, 1914. Date of appl., April 15, 1914.

THE alloy consists of Al 100, Cu 18, Zn 5, Sb 3 parts by weight. A portion of the aluminium is melted and heated to a high temperature. The copper, antimony, and balance of aluminium are then introduced in turn, the temperature allowed to fall, the zinc added, and the whole well agitated.—T. St.

Aluminium alloys. W. A. McAdams, Bay Shore, N.Y. U.S. Pats. (A) 1,121,268 and (B) 1,121,269, Dec. 15, 1914. Date of appls., April 15, 1914.

ALLOYS composed of (A) Al 100, Ag 20, Zn 10, and Cu 5; and (B) Al 100, Cd 30, Sn 5 parts by weight.—T. St.

Gold; Process of recovering rusty—and native platinum metals. R. E. Lyons, Bloomington, Ind. U.S. Pat. 1,118,944, Dec. 1, 1914. Date of appl., Nov. 17, 1913.

MATERIAL containing particles of precious metal which will not normally amalgamate, is treated with an amalgam, which is normally stable in water and contains a metal more electro-positive than mercury, and capable of alloying with the precious metal at ordinary temperatures. A reagent is also added which will attack the metal in the amalgam so that hydrogen is evolved on the surface of the precious metal, whereby the latter can become amalgamated.—T. St.

Metals; Process and apparatus for recovering precious—F. A. Wiswell, Oakland, Cal. U.S. Pats. 1,120,175 and 1,120,637, Dec. 8, 1914. Date of appls., Feb. 11, 1914.

FINELY divided material containing fine particles of precious metals is subjected, with agitation, to the action of an aqueous solution of mercuric chloride and sulphuric acid in the presence of iron, and at the same time an electric current having its

polarity periodically reversed is passed through the mass. The precious metals become amalgamated, and the mass containing the amalgamated particles is then passed into metallic mercury. The apparatus comprises a rotatory drum mounted inside a horizontal outer shell by means of engaging teeth. The drum contains an axial bore through which passes a shaft rigidly fastened to the apertured heads of the bore. The shaft is spaced from the bore and extends through the outer shell. Inlet and outlet conduits lead into opposite ends of the shell. The drum and the shell are insulated from each other and are connected respectively with the opposite poles of a source of current.—T. St.

Metals; Process of reducing—C. G. Fink, Schenectady, Assignor to General Electric Co., New York. U.S. Pat. 1,119,588, Dec. 1, 1914. Date of appl., Feb. 9, 1910.

A METALLIC arsenide (smaltite) is intimately mixed in the powdered form with powdered calcium oxide and carbide, and the mixture heated to the reaction temperature under reduced pressure.—T. St.

Ores; Method of forming agglomerated bodies from—W. Schumacher, Osnabrück, Germany, Assignor to General Briquetting Co., New York. U.S. Pat. 1,121,048, Dec. 15, 1914. Date of appl., April 30, 1912.

FINE ores of the hematite or limonite groups are reduced in the presence of lime to a lower state of oxidation, reduction to metallic iron being prevented. The reduced ore is briquetted in presence of a suitable catalytic agent for use in the blast-furnace, cohesion of the particles being brought about by reoxidation of the lower oxides previously formed.—T. St.

Ovens and dryers suitable for use in the manufacture of tiles, bricks, pottery, for annealing, etc. Eng. Pat. 18,821. See VIII.

Rubber-coated metal surface and method of producing the same. U.S. Pat. 1,120,795. See XIV.

XI.—ELECTRO-CHEMISTRY.

Insulation of electric conductors; Action of acid mine water on—H. H. Clark and L. C. Hsley. U.S. Bureau of Mines. Techn. Paper 58, 1913, 24 pages.

FOUR different types of insulation were used in the tests: (1) Wire (0.162 in. diam.) covered with eight layers of varnished cotton cambric (0.146 in. thick), and one layer of cotton braid (0.056 in. thick), saturated with a composition. (2) Wire (0.325 in. diam.); rubber layer (0.0925 in. thick), containing 30% Para; cotton tape (single layer); cotton braid with weatherproof finish (2 layers, 0.035 in. and 0.033 in. thick). (3) Wire (0.162 in. diam.); varnished cambric, 11 layers (0.116 in. thick); cotton braid with weatherproof finish (2 layers, 0.029 in. and 0.04 in. thick). (4) Lead-sheathed telephone cable, composed of 5 pairs of paper-covered wires, surrounded by lead $\frac{1}{8}$ in. thick. The cables were sprinkled with 0.45% sulphuric acid or a 1.2% solution of ferrous sulphate in this acid three times daily for the first 4 weeks, once daily for 10 weeks, twice daily for 76 weeks and subsequently once daily, and, beginning eight months after the tests were started, the insulation resistance was measured at intervals over a period of two years. The rubber insulation showed no

apparent deterioration, and the insulation resistance, although only about half the original, was still very good. The telephone cable also gave good results. The cambric-covered wires, (1) and (3), had practically lost their insulation, mainly through the penetration of the liquid between the layers.—E. W. L.

Temperature uniformity in an electric furnace; Production of—A. W. Gray. Bull. Bureau of Standards (U.S.A.), 1914, 10, 451—473.

UNIFORMITY of temperature longitudinally in a furnace tube is best obtained by inserting in each end of the tube a double plug composed of two blocks of material of high heat conductivity, separated by a considerable layer of a poor conductor, the outer block of each plug being heated to a temperature approximately the same as that of the middle of the furnace tube by a heating coil abutting against its outer end. By applying this principle a furnace was constructed in which it was possible to heat the middle 30 cm. of a furnace tube, 62 cm. long, so uniformly at temperatures up to 700° C., that irregularities in the temperature distribution were less than the effect of heterogeneity in the thermo-element. The middle portion of the furnace tube was completely filled by an iron block, in which were two longitudinal cavities of square cross-section, disposed respectively above and below the axis of the tube and serving for the reception of the bar to be heated and of a control bar. The ends of the tube were closed by double plugs as described above. The furnace tube was enclosed by two spaced concentric iron heating tubes with air in the intermediate spaces, the space between the larger heating tube and the outer shell of the furnace being filled with a composition of asbestos and magnesia. The ends of the furnace were closed by insulating heads composed of two discs of asbestos board separated by a layer of asbestos-magnesia composition. The heating tubes were wound longitudinally with nichrome ribbon, a flat, woven mat of the ribbon and strips of micasbestos (an insulating preparation of flake mica and a resinous cement) being wrapped around the tube, between layers of micasbestos, and the whole covered with asbestos cloth. The resistance was formed in two halves, which were connected in parallel. With this furnace the maximum drop in temperature at the ends of the middle 30 cm. of the furnace from the temperature at the middle was 1° at 667° C. and 0.25° C. at 145° C., and the mean temperature in the whole 30 cm. was lower than the temperature at the middle by 0.37° at 667° C. and 0.08° at 145° C.

—A. S.

Silver voltameter; The—Part IV. E. B. Rosa, G. W. Vinal, and A. S. McDaniel. Bull. Bureau of Standards (U.S.A.), 1914, 10, 475—536. (See also this J., 1914, 482.)

DETERMINATIONS of the voltage of the Weston normal cell, using silver voltameters of the porous cup type and of the new form devised by F. E. Smith (Nat. Phys. Lab. Report, 1910, 32) gave concordant results, the value at 20° C. being 1.01827 volts. With a pure electrolyte in the voltameter, the effect of acid can be expressed by the equation: $y = -4.5x + 0.02x^2$, where x represents the acidity and y the decrease in the silver deposit, both in parts per million. With a pure electrolyte the deposited silver contains no appreciable quantity of included matter. It is concluded from the whole of the results obtained at the Bureau of Standards that the silver voltameter is an instrument of precision capable of checking the constancy of the Weston normal

cell according to the decision of the International Technical Committee. A simple form of silver voltameter giving results accurate to within a few hundredths of 1% is described and illustrated, the anode being a large silver ring set in a glass dish containing the electrolyte, and the cathode a small platinum ring (10.5 grms.) resting in a shallow glass dish submerged in the electrolyte and so arranged that the whole could be lifted out together.—A. S.

PATENTS.

Anodes; Suspension of electrolytic—H. R. Boissier, Long Island, N.Y. Eng. Pat. 11,610, May 11, 1914. Under Int. Conv., May 9, 1913.

THE anode is formed with a projecting neck, either grooved or with projections on one or opposite sides, so that it may be engaged with detachable hooks or clamps.—B. N.

Particles present in an ionised medium; [Electrically] collecting—W. W. Strong, Mechanicsburg, Pa. U.S. Pat. 1,096,765, May 12, 1914. Date of appl., Dec. 28, 1912.

THE particles are separated by subjecting the ionised medium to the influence of an electric field, and are collected on a suitable movable dielectric element placed between the most intense part of the field and the medium.—B. N.

Separating finely-divided particles of solids or liquids from a gas. W. W. Strong, Pittsburgh, and A. F. Nesbit, Wilkensburg, Pa., Assignors to R. B. Mellon, Pittsburgh, Pa. U.S. Pat. 1,120,561, Dec. 8, 1914. Date of appl., Feb. 11, 1913.

SUSPENDED particles are separated from gaseous and liquid bodies by the action of an electric field, between electrodes maintained at a high difference of potential, oscillatory in character and of high frequency. The amplitude and damping of the oscillations are controlled by pre-determined and adjustable values of resistance, self-inductance, and capacity. The electrodes are arranged in a circuit which has one or more spark gaps, flame discharges being prevented in the gaps.—B. N.

Gases; [Electrical] purification of [combustible]—E. L. Hall, Assignor to Security Savings and Trust Co., Portland, Ore. U.S. Pat. 1,120,475, Dec. 8, 1914. Date of appl., April 4, 1913.

THE combustible gas is purified by partially removing sulphur compounds, and then altering the character of the remaining impurity by the action of a silent electric discharge; the altered sulphur compounds are finally removed by absorption.—B. N.

Moulded metallic article [dynamo-brush] and method of making the same. W. R. Whitney, Schenectady, Assignor to General Electric Co. New York. U.S. Pat. 1,121,960, Dec. 22, 1914. Date of appl., Oct. 12, 1910.

SEE Eng. Pat. 27,621 of 1911; this J., 1912, 1187.

Obtaining elements with the aid of volatile compounds of the same. Fr. Pat. 469,355. See VII.

Electric furnace intended principally for the manufacture of nitrides. Fr. Pat. 469,564. See VII.

XII.—FATS; OILS; WAXES.

China wood oil (tung oil); Index to patents, technology, and bibliography of —. Compiled and published by G. H. Stevens and J. W. Armitage.

AN index, covering 135 pages, to a compilation of over 800 publications and nearly 200 patents relating to Chinese wood oil. The patent specifications are given in their original form, and in all cases translations are given in full if the original text was not in English. The matter is arranged on about 2000 sheets, 8½ by 11½ ins., gathered in loose-leaf binders into four volumes, with ample space left for inserts. Only a small manuscript edition has been prepared. Further particulars may be obtained from G. H. Stevens, 77, Orange Avenue, Irvington, N.J., U.S.A.

PATENTS.

Seeds, nuts, and other oil-containing materials and substances; Expressing of oil from — and liquid from liquid-containing substances and the like. G. R. Schueler, Kingston-upon-Hull, and H. V. Wright, Brough, Yorks. Eng. Pat. 27,994, Dec. 5, 1913.

THE material is forced under pressure through a chamber the diameter of which gradually increases. The interior of the chamber may be either plain, grooved, or arranged in steps, and the outlet end is fitted with a device which regulates the size of the opening and takes up the pressure put upon the material. The expansion of the material as it passes through the chamber causes a continuous re-arrangement of the particles, thereby allowing the oil to escape freely.—W. P. S.

Polymerised products from animal oils; Process for the manufacture of —. W. Kaempfe, Grossenhain, Germany. U.S. Pat. 1,121,925 and 1,121,926, Dec. 22, 1914. Dates of appl., April 8 and Sept. 30, 1913.

SEE Fr. Pat. 445,565 and Eng. Pat. 21,835 of 1913; this J., 1913, 34; 1914, 604.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

The higher oxides of lead and their dissociation. Reinders and Hamburger. See VII.

Varnishes and coatings of cellulose acetate. Clement and Rivière. See V.

PATENTS.

Lead oxide; Method of, and apparatus for carbonating —. F. H. Sharpe, Liverpool. Eng. Pat. 17,579, July 24, 1914.

LITHARGE, water and a little acetic acid are fed through a pipe and cock into the upper end of a vertical cylindrical carbonating vessel, with a conical lower half and spherically-rounded bottom. The carbonating gas is pumped in through a central vertical pipe, ending in a bell-mouth close to the bottom of the vessel, and having lateral branches just above the delivery end, these branch pipes being curved in such a way as to impart an upward whirling motion to the liquid and suspended solids. When samples drawn from a test-cock in the side of the vessel indicate that

the carbonating process is complete, the contents of the vessel are blown out through a cock near the bottom.—E. W. L.

[Pigment] furnace. C. D. Holley, Assignor to Acme White Lead and Color Works, Detroit, Mich. U.S. Pat. 1,116,703, Nov. 10, 1914. Date of appl., Mar. 3, 1911. Renewed Apr. 9, 1914.

ABOVE the low arched roof of the furnace chamber is a waste-gas chamber. Burners open into the furnace chamber at different points near the front, and there are also a door at the front and a pair of spaced doors at the back of the chamber. Communication between the furnace chamber and waste gas chamber is established by ports, controlled by dampers, of which there are one above each door and one in the roof between the pair of doors. By this arrangement it is possible to circulate flame gases under the arched roof and over any part of the hearth as desired.—A. S.

Ultramarine; Crucible furnace, heated by gas, for the manufacture of —. Le Bleu d'Ontremere. Fr. Pat. 469,240, May 14, 1913.

UNDER the hearth of the furnace are two superposed series of horizontal gas and air flues. Gas from two or more producers is delivered to some of the lower flues and flows thence into the corresponding upper flues through openings, the size of which increases with the distance from the inlet. The air is supplied in a similar manner through the other flues, flowing in the opposite direction to that of the gas. The hot gases from the combustion chamber in the middle of the lower part of the furnace pass through openings in the lower part of the walls of the furnace and then through two conduits to the chimney. One conduit is divided in the middle by a partition to cause the gases to take a longer path and thus allow their heat to be more completely utilised. The temperature of the furnace can be regulated by varying the number of gas producers used and also by means of dampers in the gas-inlet flues.—A. S.

Colouring matters [pigments]; Manufacture of yellow to brown — from iron sulphide. Bayerische A.-G. für Chem. u. Landwirtschaftlich-Chem. Fabrikate, H. Hackl, and H. Bunzel. Fr. Pat. 469,711, March 16, 1914.

YELLOW to brown pigments of good covering power are obtained by the atmospheric oxidation of hydrated sulphide of iron, preferably in presence of moisture. For example, waste ferrous chloride solution from the pickling of iron is treated with barium sulphide solution, and the precipitated iron sulphide is oxidised by means of air, filtered off, and washed. The free sulphur may be removed by a suitable solvent if desired.—A. S.

Ink; Process for making —. R. Hochstetter, Cincinnati, Ohio. U.S. Pat. 1,119,960, Dec. 8, 1914. Date of appl., Feb. 4, 1914.

A PULP colour is mixed with a varnish, separated water is drawn off, and the mixture is dried by heating and agitation under reduced pressure.—W. P. S.

Rosin; Process for purifying —. H. T. Yaryan, Assignor to The Yaryan Naval Stores Co., Toledo, Ohio. U.S. Pat. 1,120,007, Dec. 8, 1914. Date of appl., Feb. 24, 1913.

MELTED rosin is passed through screens and allowed to fall, in a finely-divided condition, through a chamber where it is subjected to the action of an ascending current of air heated to above the melting point of the rosin.—W. P. S.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Indiarubber production in 1914. S. Figgis and Co., London. *India Rubber J.*, 1915, 49, 77—79.

IN 1914, 14,800 tons of plantation rubber were exported from Ceylon and India and 49,700 tons from Malaya, etc., as compared with 11,830 and 36,200 tons respectively in 1913; the 1914 figures do not include some direct Dutch shipments. The supply from Brazil, including Amazonas, Bolivia, Peru, etc., was 37,000 tons in 1914, against 39,000 tons in 1913. The total production of raw rubber in 1914 is estimated at 115,500 tons. Practically no guayule was made and less reclaimed rubber was used. Exports in 1914 from West Africa amounted to 8500 tons, from Loanda 450 tons, and from Congo, French Congo, and Sudan, 3900 tons, the corresponding figures for 1913 being 10,000, 400, and 4400 tons respectively. England imported 2650 tons and France 1700 tons from W. Africa in 1914.

Action of acid mine water on insulation of electric cables. Clark and Ilsley. *See XI.*

PATENTS.

Rubber; Manufacture of [raw]. — R. C. Fulton and D. A. MacCallum, Glasgow. *Eng. Pat.* 9066, April 9, 1914.

LATEX is coagulated by spraying it into, or otherwise mixing it with, a dilute (10—20%) solution of an aldehyde or ketone, such as acetaldehyde or acetone, in water or other inert solvent, except alcohol. The ultimate weight of the rubber is increased from 3—5% by the precipitation with it of protein, which is claimed to improve the quality. It is advantageous to add 1% of formalin to the latex before coagulation, to prevent or check subsequent putrefactive changes.—E. W. L.

Rubber-coated metal article and method of producing the same. L. Datt, Rutherford, N.J., Assignor to Electro-Chemical Rubber and Manfg. Co. U.S. Pat. 1,120,795, Dec. 15, 1914. Date of appl., Feb. 17, 1912.

A RUBBER covering is fixed by vulcanisation, on a metal surface containing bismuth, with or without one or more of the metals, copper, zinc, and arsenic, but not tin.—E. W. L.

XV.—LEATHER; BONE; HORN; GLUE.

Tanning materials; Supply of. — Ch. of Comm. J., Jan., 1915.

IN 1913 the value of tanning extracts of all kinds imported into the United Kingdom reached £922,600. Supplies from Italy have now been wholly, and from France partially, stopped owing to the increased demand for military purposes. Quebracho extract is arriving in fair quantities from South America, but with the higher freight and insurance and the increased demand the price is bound to rise materially. The supply of Turkish valonia is cut off. Fortunately both South Africa and, in a lesser degree, the Commonwealth of Australia have for some years done a considerable export trade in wattle-bark, while East Africa is also now in a position to begin sending shipments. The value of wattle-bark for tanning has been sufficiently demonstrated by experiments conducted at the Imperial Institute. Wattle-bark has been used, moreover, and highly appreciated for some time in Germany, where the bulk of the supply forwarded to Europe from the British Colonies has hitherto been ultimately sent. As a large and constant supply is available at a price which is very low as compared with that of valonia

(which wattle-bark should be able to replace), it is hoped that wattle-bark will now be regularly used by British tanners.

PATENT.

Gelatine; Obtaining — from fish-bones, and subsequent treatment of said gelatine. G. H. Tatham, D. R. Blair, C. T. Westwood, and J. H. Dunkin, London. *Eng. Pat.* 28,453, Dec. 10, 1913.

FISH-BONES, freed from adhering flesh, are soaked for several days in running water, then freed from calcium salts by treatment with a 10% solution of alkali (potassium silicate) or acid (hydrochloric), and heated with a solution of potassium bicarbonate (2 to 3 grains in one pint of water per lb. of bones) in a steam-jacketed pan at 105°—110° C. for 25—40 hours. The steam pressure is slowly released, and commercially pure sheet gelatin (5% of the weight of bones) added. The clearer portion of the gelatin collects on this, and the darker, less soluble portion separates from it. The latter is purified by means of fullers' earth, kaolin, etc., whilst the clearer, soluble part is worked into the required form and rendered insoluble with formaldehyde or 10% tannic acid. The latter produces a product which darkens on exposure to light.—E. W. L.

XVI.—SOILS; FERTILISERS.

Manure heaps; Prevention of loss from — in winter and early spring. E. J. Russell and E. H. Richards. *J. Board Agric.*, 1914, 21, 800—807.

THE losses occurring during storage of a manure heap arise from rainfall, dissipation of gaseous compounds, and moving the heap. They can be prevented altogether under favourable conditions. In heaps stored in the open and under cover, the losses in nitrogen were 24—33% and 7—8% respectively. When a heap under cover was compacted so as to prevent dissipation of gas, the loss of nitrogen was nil. Moving the heap caused a loss of nitrogen varying from 10 to 27% under all conditions, whether covered or uncovered, compacted or not compacted. The nitrates formed on the outside of the heap are washed by rain into the heap and there undergo decomposition with evolution of gaseous nitrogen. To prevent loss the heap should be compacted, sheltered from rain, and undisturbed.—J. H. J.

Silicofluorides; Manufacture of — and the superphosphate industry. A. Hutin. *Rev. Chim. Ind.* 1914, 188. *L'Ind. Chimica, Min. e Met.* 1914, 1, 485—486.

MOST mineral phosphates contain fluorine, and in the manufacture of superphosphate this is converted into hydrofluosilicic acid, which is usually allowed to go to waste. By drawing the gases from the superphosphate chamber through a lead-lined tower in which they meet a spray of brine the acid is converted into sodium silicofluoride, which can be separated by filtration. The cost of recovery is very small and the sodium silicofluoride is worth about lire 50 per quintal (£20 per ton).—A. S.

Lime and magnesia; Comparison of silicates and carbonates as sources of — for plants. W. H. MacIntire and L. G. Willis. *J. Ind. Eng. Chem.*, 1914, 6, 1005—1008.

IF the ordinary methods of analysis be used, many soils may be described as containing carbonate when none is present (compare Marr, this J., 1909, 1213). The authors have shown previously (*Tenn. Stat. Bull.* No. 100) that by

using a vacuum of 4 ins., calcium carbonate in a soil can be completely decomposed and the carbon dioxide liberated at the ordinary temperature by means of phosphoric acid (1:15), which also has less action than hydrochloric acid on soil organic matter. Calcium is present in soils very often, and magnesium almost always, as silicate, and the silicates are more beneficial to the plants than the corresponding carbonates. The long-continued effects of the application of small or moderate amounts of burnt lime or calcium carbonate are due to the conservation of lime as silicate, from which lime is extracted in the form of bicarbonate by the soil solution.—A. S.

Felspar as a possible source of American potash. Cushman and Coggeshall. See VII.

PATENTS.

Manures or fertilisers; [Manufacture of] artificial —. T. Twynam, Redcar, Yorks., E. K. Scott, Belvedere, Kent, and F. Howles, Manchester. Eng. Pat. 6275, March 12, 1914.

FINELY divided, phosphatic, basic slag is agitated, and treated at a moderate temperature with oxides of nitrogen and air issuing from a nitrogen-fixation furnace, operated by a high-tension electric arc. The necessary temperature is maintained by spraying water on to the slag or by the use of a sludge composed of ground slag and water. The resulting product contains citric-soluble phosphoric acid and the nitrates of the bases existing in the slag other than iron, which is only attacked at a higher temperature.—O. R.

Fertiliser and process of making the same. W. F. Downs, Jersey City, N.J. U.S. Pat. 1,120,917, Dec. 15, 1914. Date of appl., Nov. 13, 1912.

FINELY divided phosphate rock is intimately mixed with sufficient finely divided silica to give a ratio of $\text{RO}:\text{SiO}_2$, and the mixture is heated to below the sintering point or the volatilising point of phosphoric anhydride ($720^\circ\text{--}1100^\circ\text{C.}$), the heating being continued until the product is insoluble in water, neutral to litmus, soluble in hydrochloric acid, and all or most of its phosphate soluble in neutral ammonium citrate.—O. R.

Soluble phosphates; Method of producing —. J. W. Beckman, Niagara Falls, N.Y. U.S. Pat. 1,121,160, Dec. 15, 1914. Date of appl., April 30, 1913.

SOLUBLE phosphates are produced by heating alunite, or other mineral of the type, $\text{R}_2\text{O}_7\cdot\text{K}_2\text{O}$, S_2O_8 , with tricalcium phosphate or other mineral phosphate excepting that of an alkali metal.—O. R.

XVII.—SUGARS; STARCHES; GUMS.

Sugar beet; Cultivation of the — in Ireland. J. Dept. Agric. and Tech. Inst., Ireland, 1914, 14, 471—482.

IN experiments carried out in 1912 and 1913, cultivation in rows on the flat in accordance with Continental practice produced a yield only 14 to 17 cwt. per acre greater, and a sucrose content only 0.3 to 0.7% higher, than cultivation on moulded up drill plots, which was not sufficient to compensate for the extra outlay involved in labour on the flat plots. Hence the system of moulding-up ordinary drills or ridges, which facilitates after-cultivation, appears to be best adapted to Irish conditions. The application of sodium nitrate was not remunerative under the conditions of manuring adopted, which in most of the experiments was as follows: farmyard manure, 15 tons; sulphate of ammonia, 1 cwt.; superphosphate,

3 cwt.; and kainit, 6 cwt. per acre. Sugar beets were grown alongside mangolds with the object of comparing the relative yields, the general averages being as follow: sugar beets (gross weight), 17 tons 9 cwt.; sugar beets (factory weight), 13 tons 10 cwt.; and mangolds, 28 tons 18 cwt. per acre. Thus, even when cultivated in the best manner, the factory weight of a sugar beet crop in Ireland was only about half that of a well-managed crop of mangolds.—J. P. O.

Sugar beet; Cultivation of the — in Canada. F. T. Shutt. Report of the Dominion Chemist, Dep. of Agric., Canada, 1913, 242—245.

VERY satisfactory results have been obtained demonstrating that sugar beets suitable for profitable extraction of sugar may be grown in widely distant parts of Canada. The highest sugar content (17.86%) was reached at Lethbridge, Alberta, and the lowest (13.40%) at Brandon, Man., and at three of the Experimental Farms it averaged 17%, the purity of the juice being over 90%. The seed used was of three varieties: Vilmorin's Improved A, Vilmorin's Improved B, and Klein Wanzleben.—J. P. O.

Sugars; Influence of atmospheric conditions in the testing of —. F. Bates and F. B. Phelps. Bull. Bureau of Standards (U.S.A.), 1914, 10, 537—555.

UNDER ordinary conditions the increase in polarisation due to evaporation is negligible in the case of refined sugar, and also with raw sugar, filtered once, provided the time required for filtration does not exceed 10—12 mins., but errors of several tenths of a sugar degree may be caused when one-fourth of the solution or more is filtered twice. In all cases error can be avoided by covering the funnel.—A. S.

Strontium in the beet sugar industry. H. C. Meyer. J. Ind. Eng. Chem., 1914, 6, 1036—1037.

THE price of refined strontium nitrate imported into the United States has trebled since August 1, 1914, and importation of crude strontium sulphate has consequently increased largely. The manufacture of strontium compounds in the United States is advocated, since at the present time the American manufacturer can purchase the raw material at a price approximating that paid by foreign manufacturers, and if a steady supply of strontium hydroxide could be assured, there would be a large demand from American beet sugar refiners for use in the desaccharification of molasses. At present either the lime or the osmosis process is used in the United States, but the strontia process is employed almost exclusively on the Continent, and, notwithstanding its higher initial cost, possesses many advantages.—A. S.

XVIII.—FERMENTATION INDUSTRIES.

Beers; Reports on the determination of the original gravity of — by the distillation process. I. and II. Memoranda and Tables. T. E. Thorpe and H. T. Brown. III. Report on the proposed revision of the Table of Original Gravities. IV. History of previous Tables of Original Gravities and a comparison of these with the Mean Brewery Table, 1909—10. V. The scientific principles underlying the empirical method of determining original gravity. H. T. Brown. J. Inst. Brew., 1914, 20, 569—713.

I. Thorpe and Brown. In 1909, the Commissioners of Customs and Excise directed a revision of the

Statutory Table of Original Gravities hitherto in use since 1880 (see this J., 1915, 45). The Commissioners instructed Sir Edward Thorpe to carry out the work in co-operation with Mr. H. T. Brown, who was nominated on behalf of the

brewing trade by the Institute of Brewing. After a study of malt worts prepared and fermented in the laboratory, the investigation was continued in ten breweries selected as representative of the various systems of brewing practised in the

TABLE I.

Readings from curves constructed from the averages of the curve readings of each brewing at each brewery, compared with the Mean Brewery Table constructed from the averages of the curve readings of all the brewings at all the breweries.

Spirit Indication.	Brewery.											Differences between "Mean Brewery Table" and—	
	A.	B.	C.	D.	E.	F.	G.	H.	K.	L.	Mean Brewery Table.	Highest brewery curve readings.	Lowest brewery curve readings.
	Corresponding degrees of gravity lost.												
1	4.25	4.30	4.25	4.25	4.20	4.35	4.20	4.20	4.25	4.20	4.25	+0.10	—0.05
2	8.55	8.65	8.55	8.60	8.50	8.75	8.50	8.50	8.55	8.45	8.50	+0.25	—0.05
3	12.95	13.05	12.90	13.05	12.95	13.20	12.85	12.85	12.90	12.75	12.90	+0.30	—0.15
4	17.45	17.55	17.40	17.55	17.45	17.65	17.25	17.30	17.40	17.05	17.30	+0.35	—0.25
5	21.95	22.10	22.00	22.10	22.05	22.20	21.80	21.85	21.90	21.50	21.85*	+0.25	—0.35
6	26.65	26.70	26.60	26.70	26.65	26.80	26.40	26.45	26.50	26.00	26.40	+0.30	—0.40
7	31.20	31.40	31.35	31.30	31.35	31.00	31.00	30.95	31.10	30.55	31.00	+0.40	—0.45
8	35.85	36.15	36.10	35.95	36.10	—	35.75	35.50	35.75	35.20	35.55	+0.50	—0.45
9	40.55	—	—	40.60	40.85	—	40.55	40.10	40.40	39.95	40.30	+0.55	—0.35
10	—	—	—	—	45.65	—	45.40	44.80	45.10	44.95	45.00	+0.65	—0.20
11	—	—	—	—	—	—	60.25	49.60	49.90	49.85	49.85	+0.40	—0.25
12	—	—	—	—	—	—	65.20	—	54.80	—	54.85	+0.35	—0.05
13	—	—	—	—	—	—	—	—	59.85	—	59.95	—	—0.10

* 21.93 true average.

TABLE II.

Original gravities of beer after storage in casks. Summary of the maximum differences between the true original gravity and the original gravity as calculated from the old Statutory Table and from the Mean Brewery Table.

Brewery.	Description of beer.	Time since cask filled.	Spirit Indication.	True original gravity.	Original gravity calculated from—			
					Old Statutory Table.	Difference from true original gravity.	Mean Brewery Table.	Difference from true original gravity.
C	Strong Ale	6 months	11.88	104.34°	101.31	—3.03	101.86	—2.48
G	"	6 "	12.14	104.34°	101.40	—2.95	101.05	—2.89
G	"	4 "	11.25	95.65°	92.50	—3.15	93.25	—2.40
G	"	4 "	11.20	95.65°	92.43	—3.22	93.18	—2.47
H	"	15 "	13.73	89.94°	86.25	—3.69	86.48	—3.46
H	"	15 "	13.79	89.94°	86.65	—3.20	86.69	—3.05
K	"	6 "	13.63	106.83°	105.02	—1.81	105.30	—1.53
K	"	6 "	13.08	106.83°	104.89	—1.94	105.36	—1.47
Mean difference ..					.. ..	—2.87	.. ..	—2.41
H	Export Stout	15 months	10.33	70.46°	68.24	—2.22	69.06	—1.40
H	"	15 "	10.19	70.46°	67.68	—2.78	68.74	—1.72
L	Stout	8 "	11.44	76.10°	74.61	—1.49	75.26	—0.84
Mean difference ..					.. ..	—2.16	.. ..	—1.33
K	Export Ale	1 day	8.59	64.69°	62.55	—2.14	64.00	—0.69
K	"	1 "	8.64	64.69°	62.76	—1.93	64.18	—0.51
K	"	6 months	9.71	64.23°	62.35	—1.86	63.48	—0.75
K	"	6 "	9.68	64.23°	62.32	—1.91	63.27	—0.96
Mean difference ..					.. ..	—1.96	.. ..	—0.73
H	Export Ale	4 months	8.98	56.87°	54.20	—2.67	55.59	—1.28
H	"	15 "	13.04	56.87°	54.20	—2.67	55.19	—1.68
E	"	15 "	9.37	55.40°	52.80	—2.60	54.58	—0.82
E	"	15 "	9.42	55.40°	52.88	—2.52	54.72	—0.68
G	"	4 "	8.33	54.49°	51.29	—3.20	53.28	—1.21
G	"	4 "	8.29	54.49°	51.38	—3.11	53.28	—1.21
F	"	4 "	7.16	49.01°	45.73	—3.28	47.96	—1.05
F	"	4 "	7.13	49.01°	45.66	—3.35	47.91	—1.10
Mean difference ..					.. ..	—2.92	.. ..	—1.13
Mean of all differences for original gravity of 90° and over ..					.. ..	—2.87	.. ..	—2.41
Mean of all differences under 80° of original gravity ..					.. ..	—2.50	.. ..	—1.06
Mean of all differences .....					.. ..	—2.63*	.. ..	—1.63*

United Kingdom. Owing to the custom of making up the worts for fermentation from separate "lengths" of varying gravities, and pitching before all the "lengths" are added, it was impossible in most cases to determine the true original gravity from samples taken from the vats. This was done, however, where possible, and the results confirmed the accuracy of the alternative method of sampling on which exclusive reliance had to be placed in other cases. This method was to take a number of samples (30—40 in some cases) of the wort from the pipe filling the vat, at suitable intervals of time, each representing a certain volume of wort run in, and to secure a "miniature collection" by mixing together volumes of the different samples proportional to the quantities of wort represented by them. Samples of the fermenting wort were withdrawn from different portions of the vat, at frequent intervals, and investigated. Owing to the impossibility of obtaining samples containing the proper proportion of yeast, except in the early stages of fermentation, it was decided to filter the worts before determining the spirit indication. All determinations were carried out independently by two analysts, and wherever possible results were "smoothed out" by means of curves. An original gravity table was compiled for each of the 42 brewings investigated, relating to worts made with malt, or malt and flaked maize, with and without brewing sugars. These tables show slight variations in the gravity lost, corresponding to a certain spirit indication. Worts of high original gravity show a smaller loss of gravity for a given spirit indication than weaker worts, but the maximum difference does not exceed 0.4° , or, if worts of original gravity exceeding 80° are excluded, 0.2° . When brewing sugars other than sucrose are used as adjuncts, the gravity lost for a given spirit indication is slightly higher than for all-malt worts, but up to a spirit indication of 8° the difference does not exceed 0.31° of gravity. Variations due to these causes, and also to differences in the reproduction of the yeast and the amount of alcohol lost in different breweries, are thus comparatively small. From the average of the results for all the brewery worts investigated, with the exception of those to which cane sugar had been added, a Mean Brewery Table (the basis of the New Statutory Table, see this J., 1915, 45) was compiled, which is shown in Table I., together with corresponding tables relating to the worts of each brewery. As may be seen from Table I., when the Mean Brewery Table is used to interpret the results of the distillation process, the extreme variations will be very small, and the Table may be accepted as the most accurate obtainable for general application. Where, as in the case of brewery L, it operates against the brewer, the authors consider that a special allowance should be made. The Table applies to filtered worts at any stage of fermentation up to the point at which they are racked into casks for consumption or storage.

When cane sugar is used as a brewing adjunct, inversion takes place in the early stages of fermentation, and this would increase the gravity by about 0.2° for every 10 lb. of sucrose in 100 galls. of wort. Owing to fermentation of the invert sugar the actual effect is always less than this, and by the time a spirit indication of 4° or at most 5° is reached, the whole of the invert sugar has disappeared and no correction is subsequently required. The authors consider that the full correction for the sucrose inverted, as stated above, should be made in all cane sugar worts which at the time of distillation have not attained a spirit indication of 5° .

II. *Thorpe and Brown.* Some of the beers investigated as described above were stored in casks in certain of the breweries, for periods

up to nearly 18 months, and samples were taken from time to time. On account of the further production of alcohol during storage, the Mean Brewery Table was extended by extrapolation from 13° to 16° of spirit indication. The results of the investigation of the stored beers are summarised in Table II. The differences between the true original gravities and those calculated from the Mean Brewery Table correspond closely with the strengths of the beers, and are evidently due to losses of alcohol during storage. The loss or apparent loss of alcohol is due to three causes:—(1) A small but sensible absorption of the beer into the wood immediately after filling, and dilution of the beer by water remaining in the wood from the washing of the casks. (2) A slight evaporation of alcohol and water through the wood. The loss of alcohol appears to be independent of the external conditions, but that of water is greater in a dry store than in a damp cellar, and therefore in the latter case the spirit indication will decrease, whilst in a dry store it will remain constant or even increase. (3) Oxidation of alcohol to acetic acid. Graham, Hofmann, and Redwood stated that fresh worts may contain 0.1% of acetic acid, and that all increase beyond this can be regarded as derived from the alcohol of the beer, for which a corresponding correction must be made in the spirit indication. The authors, however, found that fresh worts contain practically no volatile acid, and that the amount produced during fermentation and storage is quite negligible so long as the beers remain sound. This was the case with all except two of the beers investigated, even after 18 months' storage. Two of the strong ales were sensibly acid at the end of storage, and the losses of gravity in these cases were the highest found, viz., 3.46° , 3.05° , and 2.48° . If the spirit indications had been corrected on the assumption that all the volatile acidity was acetic acid derived from alcohol, the losses would have been nearly 1° lower. In exceptional cases of this kind the volatile acidity has to be estimated and allowed for. The official method of determining acetic acid in beers, by titrating with standard ammonia solution and deducting 0.1% from the total acidity so found, is not satisfactory. The best method is by distillation in steam; and a more convenient one, though not in all cases quite so accurate, is to reckon as acetic acid the loss of acidity of a sample of the beer after evaporating to dryness on an open steam bath.

The last column of Table II. makes it evident that when beer is exported on drawback, or in other similar circumstances, an allowance of 2° on the declared gravity is a sufficient margin to cover all losses during storage due to differences between the true original gravity of the beer and that calculated from the Mean Brewery Table in the case of all beers of an original gravity not exceeding 90° . For beers of a higher original gravity a margin of 3° might be allowed.

III. *Brown.* A more detailed report of the investigation. The influence of yeast reproduction is discussed very fully. For the filtration of the wort prior to distillation ordinary filter paper was used, and the first portions of filtrate were rejected. No sensible loss of alcohol occurs if the funnel is covered with a clock glass.

IV. The necessity for a suitable means of determining original gravity first arose in 1847, when the use of sugar as a brewing adjunct was legalised, and the drawback of Excise Duty on exported beers was made calculable from the original wort gravity. The table first employed was one compiled by Dobson and Phillips, based on the method of partial evaporation. Its accuracy was disputed, however, and in 1852 Graham, Hofmann and Redwood were appointed to examine and if necessary revise the table. Their table, based on the method of distillation, accorded well with that

of Dobson and Phillips, and has been enforced by statute since 1880. Compared with this table, the Mean Brewery Table operates adversely to the brewer by indicating higher amounts of gravity lost for a given spirit indication, and therefore lower original gravities. In no case, however, does the difference corresponding to any spirit indication exceed 1.45° of gravity lost, if allowance is made for the fact that the Mean Brewery Table refers to filtered, and the older table to unfiltered worts. The inaccuracy of the older table is mainly due to the fact that in their fermentation experiments Graham, Hofmann and Redwood employed about six times as much yeast as is used on the average in brewing. Under these conditions very little yeast reproduction can have occurred, so that the loss of extract by assimilation must have been abnormally low, and moreover an appreciable amount of alcohol must have been added to the wort with the yeast.

V. Brown. The author sought a rational basis for the determination of original gravity by the distillation method, by taking account of the various causes which contribute to the loss of gravity during fermentation. The Mean Brewery Table was re-calculated so as to refer the gravity lost to the weight of alcohol in 100 c.c. of the beer instead of to the spirit indication. The values thus obtained are shown in columns 1 and 2 of Table III, whilst column 3 reveals the almost exact rectilinear relation between them. This direct proportionality must be due to mutual compensation of the effects of various disturbing factors of which the chief is the assimilation of extract required for yeast reproduction. As a rule, in malt worts the rate of multiplication of the yeast falls off rapidly after the alcohol-content has reached about 0.5%, and practically ceases when the alcohol-content is about 3%. The loss of gravity owing to yeast reproduction may be calculated by multiplying the weight of yeast (dry substance) formed, by 4.5, and in brewery worts it amounts on the average to 1.6° of gravity. In column 4 of Table III are shown the values of column 2 corrected for this loss of gravity apportioned according to the magnitude of the yeast crop at different stages. Here again (as shown in column 5) the loss of extract remains almost exactly proportional to the quantity of alcohol formed, although various sugars are present in wort and their solution densities change with the concentration. The slight irregularities corresponding to the earlier stages of fermentation (see col. 5) are mainly due to the sucrose derived from the malt, the inversion of which tends to raise the original gravity of the wort and thus diminish the gravity lost. Malt worts contain 0.484—1.274% of sucrose, and the complete inversion of this would raise the gravity by 0.11—0.29°; but owing to the fermentation of the invert sugar the actual effect must always be less than this, and is quite negligible after the alcohol-content has attained 1.5%. The change in volume of wort due to fermentation is far too small to have any practical bearing on the present investigation. The sugars of malt wort yield, in the aggregate, a larger percentage of alcohol than the same sugars do when fermented alone by yeast which is not under conditions favourable for reproduction; this fact deserves further study.

In column 6 of Table III are shown the quantities of alcohol produced, expressed as percentage of the sugar fermented (calculated from the corrected losses of gravity in column 4 by means of the solution factor 3.912). On the basis of these figures the author divides the period of fermentation into three stages, according as the alcohol-content of the wort is below 1.5%, between 1.5 and 3%, or above 3%. For these stages the average yields of alcohol per cent. of sugar

fermented are 55.7, 52.6, and 51.5% respectively, and conversely the factors 1.795, 1.901, and 1.941 may be used for calculating the weight of sugar fermented for a given weight of alcohol formed. The original gravity of a wort may be calculated from the residue gravity by means of the formula, Original gravity = Residue gravity + 3.912 × S + Y, in which 3.912 is the solution factor for the aggregate wort sugars, S is the weight of sugar which has disappeared, expressed as grms. per 100 c.c., and is found by multiplying the percentage of alcohol in the wort by one of the factors 1.795, 1.901, or 1.941, according to the stage reached by the fermentation (see above), and Y is the loss of gravity due to the assimilation of extract by the yeast. This formula gives values very close to the true original gravity in all cases.

TABLE III.

1	2	3	4	5	6
Alcohol grms. per 100 c.c.	Corresponding density lost, from Mean Brewery Table.	Gravity lost for successive increments of 0.5 grm. of alcohol.	Values of Col. 2 corrected for yeast reproduction.	Values of Col. 3 corrected for yeast reproduction.	Percentage of alcohol on total solid (divisor 3.912).
0.5	4.00	4.00	3.38	3.33	58.0
1.0	8.00	4.00	7.11	3.73	55.1
1.5	12.00	4.00	10.90	3.79	54.0
2.0	16.05	4.05	14.73	3.83	53.1
2.5	20.10	4.05	18.60	3.84	52.7
3.0	24.10	4.00	22.50	3.60	52.2
3.5*	28.05	3.95	26.45	3.65	51.6
4.0	32.00	3.95	30.40	3.95	51.5
4.5	35.85	3.85	34.25	3.85	51.5
5.0	39.65	3.80	38.05	3.80	51.5
5.5	43.45	3.80	41.85	3.80	51.5
6.0	47.25	3.80	45.65	3.80	51.5
6.5	51.05	3.80	49.45	3.80	51.5
7.0	54.90	3.85	53.30	3.85	51.5
7.5	58.70	3.85	57.15	3.85	51.5

* Yeast reproduction ceases at this point.

Determination of original gravity by the method of evaporation.—In the course of the main investigation the gravity of the fermented worts was in many cases ascertained prior to the determination of the spirit indication by distillation. In 33 such cases, with worts of original gravities ranging from 1054—1075, the spirit indication, as found by subtracting the gravity of the wort before distillation from that of the residue made up to the same volume, was on the average 0.16° less than the spirit indication of the distillate. This difference was very constant, and apparently independent of the original gravity of the worts; it is partly accounted for by the greater contraction which alcohol undergoes when mixed with sugar solutions than when mixed with water alone. The general result indicates that in the determination of original gravity by evaporation the same table (Mean Brewery Table) can be used as for the distillation process, provided the observed spirit indication in the former case be increased by 0.16°.

—J. H. L.

Alcohol for industrial purposes. See page 53.

XIXA.—FOODS.

Cheese of the cheddar type; Bacteria concerned in the production of the characteristic flavour in
— A. C. Evans, E. G. Hastings, and E. B. Hart. J. Agric. Research, 1914, 2, 167—192.

THE organisms present in cheddar cheese in such numbers as to indicate that they must have some function in the ripening process, are included in the four groups: *B. lactis acidii*, *B. casei*, *Streptococcus*, and *Micrococcus*; each of these groups may be divided into a number of varieties according to

their fermentative powers. The flora of raw-milk cheese consists of all the varieties into which the four groups are divided, whilst the flora of pasteurised-milk cheese, with the exception of the *B. casei* group, is dependent upon the flora of the starter. The *B. casei* group is apparently responsible for the pungent taste which develops late in the ripening period of both raw-milk and pasteurised-milk cheeses; probably the growth of this group of organisms continues during the greater part of the ripening period. The action of two or more organisms growing together is not the sum of their individual actions when growing alone. When growing together, they may attack substances that neither can attack alone, or they may produce a larger quantity of acid than the sum of the quantities that either can produce alone. The organisms of the *B. casei* group, when added to pasteurised milk, produce a sour taste in the cheese during the early part of the ripening period, but no cheddar flavour develops when the starter consists of organisms of this group; the varieties capable of fermenting the more complex substances are liable to produce a bitter flavour. Starters composed of both *B. lactis acidii* b, and *Streptococcus* b, when added to pasteurised milk, improve the quality of the cheese and possibly starters may be discovered which will give the characteristic cheddar flavour to cheese prepared from pasteurised milk.—W. P. S.

Cheese of the cheddar type; Relation of the action of certain bacteria to the ripening of— E. B. Hart, E. G. Hastings, E. M. Flint, and A. C. Evans. *J. Agric. Research*, 1914, 2, 193—216.

VARIETIES of *Streptococci* and *Micrococci* isolated from cheddar cheese produce large quantities of volatile acids, particularly acetic acid, when grown in sterilised milk; no formic acid is produced. The volatile acids result from the action of the organisms on the citric acid, lactose, or protein in the medium, and, as the organisms are present at times in very large numbers in cheese, they no doubt produce the greater part of the volatile fatty acids during the ripening process. One of the varieties of *Streptococcus* b forms comparatively large quantities of alcohols and esters which contribute to the flavour of the cheese. Lactic acid is not usually produced by the *Coccus* groups. The *B. casei* group of organisms yield results differing from those given by the *Coccus* groups; they form some propionic acid and large quantities of acetic acid and lactic acid (both active and racemic), but no formic acid. Cheese made from fresh milk containing chloroform does not contain any volatile fatty acids, showing that these are not formed by the inherent milk enzymes. Ammonia is produced both by the *Coccus* and *B. casei* groups when these grow in milk. Whey and fresh curds contain active lactic acid, whilst cheese 1 day old contains a mixture of active and racemic lactic acids. Certain members of the *B. casei* group form l-lactic acid and others d-lactic acid from milk; a mixture of these organisms produces racemic lactic acid. When a mixed culture of *B. lactis acidii* and the members of the *B. casei* group capable of forming l-lactic acid is allowed to grow in milk, racemic and active lactic acids are produced; the active acid is probably the result of the longer continued activity of *B. casei*. The racemic lactic acid found in cheese during the curing process may be produced to a small extent by enzymic action, but is more probably due to the combined action of *B. lactis acidii* and the organisms of the *B. casei* group.—W. P. S.

Peroxydase in milk; Rate of inactivation by heat of— S. S. Zilva. *Biochem. J.*, 1914, 8, 656—669.

THE temperature coefficient for the inactivation of peroxydase in milk is found to be 2.23 per degree

Centigrade, a value about the same as that of the rate of coagulation of egg-albumin. The rate of inactivation of peroxydase below 70° C. is so small that the peroxydase reaction cannot be used as a test for pasteurisation. This reaction may, however, indicate whether "pasteurised" milk has been overheated. Small additions of acid retard, and of alkali accelerate, the rate of inactivation, whilst the presence of salts has a marked retarding effect, the retardation varying with different salts and being independent of the valencies of their ions. Salts have a similar action in the case of the enzyme in whey. As in milk, the inactivation of peroxydase in whey proceeds as a reaction of the first order.—W. P. S.

Rice-polishings; Investigation of the phosphotungstate precipitate from— J. C. Drummond and C. Funk. *Biochem. J.*, 1914, 8, 598—615.

EXHAUSTIVE fractionation of the phosphotungstic acid precipitate obtained from an alcoholic extract of rice-polishings (husks) showed that the latter contain considerable quantities of choline and nicotinic acid; betaine, adenine, guanine, and possibly guanidine, were also detected. The substance, oryzanin, which is stated to have a powerful curative effect when administered in cases of beriberi produced by a diet of polished rice, could not be isolated (compare Suzuki, Shimamura and Otake; *Biochem. Zeitsch.*, 1912, 43, 89).—W. P. S.

Hydrocyanic acid from commercial kinds of linseed: Rate of liberation of— S. H. Collins and H. Blair. *Chem. News*, 1915, 111, 10—20.

THE first crops of linseed grown in England from foreign seed of different origin showed great variations in the amounts of hydrocyanic acid to be obtained from them and in the rate of its evolution. For example the following amounts were obtained:—Russian, 0.088 to 0.175; German, 0.213; Roumanian, 0.115 and 0.183; Moroccan, 0.112; Indian, 0.210 to 0.233; and Japanese 0.270 parts per 1000. The Oriental seeds also showed low rates (35 to 55 mins.) for the evolution of half the total amount of hydrocyanic acid. The general result of growing linseed in England is to reduce the total amount of hydrocyanic acid and to increase the enzymic activity. English grown seed thus appears to be safer than foreign grown seed for feeding cattle. Seeds derived from temperate climates appear to give the best yields per acre and to produce linseed containing the smallest amount of cyanogenetic glucosides. (See also this *J.*, 1914, 273.)—C. A. M.

Brewers' grains as a feeding material; Value of dried— E. T. Halnan. *J. Board Agric.*, 1914, 21, 821—825.

A COLLECTION of the data available on the feeding of cattle and sheep with brewers' grains. In Norfolk, sheep were fed on swedes and hay, together with equal weights of various mixtures of grains and seeds. The average gain per head per week during three months was 3.13 lb. in the case of cotton cake and dried grains, 3 lb. for cotton cake and barley, 3.14 lb. for linseed and dried grains, and 3.04 lb. for linseed and wheat. The grains were thus superior to wheat and barley in these mixtures. The price of the brewers' grains, £6 per ton, was less than that of the other foods used. In Scotland, sheep were fed with swedes and $\frac{1}{2}$ lb. of linseed, maize, oats, or dried grains, and the last proved much superior to any of the other foods. Later experiments with sheep fed on swedes and hay, with the addition of a fattening food, showed that the best increase in weight occurred with undecorticated Bombay cotton cake, followed by a mixture of undecorticated cotton cake and dried grains, linseed, and a mixture of

decorticated cotton cake and dried grains in the order given. The cost of the Bombay cake was £46s. 8d. per ton and of the dried grains £5 1s. 8d., so that the former gave the better feeding value. In another series, brewers' grains at £5 12s. 6d. were inferior to linseed at £8 5s., but superior to oats and maize. The general result of the investigations is that brewers' grains can be used with advantage to replace the more expensive cereals. The analyses of the brewers' grains used averaged approximately as follows: moisture 12, proteins 20, oil 8, fibre 12, nitrogen-free extract 45, ash 2.65%.—J. H. J.

PATENTS.

Meat products and the like; Process and apparatus for smoking and curing.—B. Schwenger, New York. Eng. Pat. 12,928, May 26, 1914. Under Int. Conv., Jan. 19, 1914.

MEAT products, such as sausages, hams, fish, etc., are suspended in a chamber at the bottom of which is a layer of sawdust, which is ignited by means of a gas burner placed below a metal hood in contact with the sawdust; subsequently the gas supply may be cut off and air injected so as to continue the combustion. The rapidity of combustion is controlled by regulating the supply of air, and a separate supply of dry air may be admitted to the upper part of the chamber. —W. P. S.

Cereal extract; Manufacture of.—A. Nilson, Chicago, Ill. U.S. Pat. 1,120,328, Dec. 8, 1914. Date of appl., June 15, 1914.

CRUSHED malted cereal in a green condition is mashed with water containing sodium chloride, the wort is drawn off, acidified, and fermented; after separating the yeast, the liquid is treated with sodium carbonate and sodium chloride, heated, precipitated albumin is separated, and the resulting liquid is concentrated. The product resembles beef extract in appearance and taste. —W. P. S.

XIXE.—WATER PURIFICATION; SANITATION.

Magnesium; Rapid determination of.—in water analysis in the presence of calcium. V. Froboese. Z. anorg. Chem., 1914, 89, 370—376.

THE calcium is precipitated by adding to 200 c.c. of the water, heated to boiling, sufficient oxalic acid to make it just acid to methyl orange and then 50% potassium hydroxide solution until faintly alkaline, excess being avoided. The cooled solution, which should have become slightly acid, is treated with N/10 KOH in presence of phenolphthalein until it is a pale rose colour, and then immediately titrated with N/10 potassium palmitate (this J., 1912, 555, and 1913, 158), the end point being indicated by the production of a distinct red coloration. With practice, results agreeing with gravimetric determinations to within a fraction of a milligram per litre, can be obtained. —G. F. M.

PATENTS.

Water purification; Method of and apparatus for.—J. Patten, Baltimore, Assignor to S. M. Shoemaker, Eccleston, Md. U.S. Pats. (A) 1,121,393 and (B) 1,121,394, Dec. 15, 1914. Date of appl., Sept. 4, 1914.

(A) Hot water is sprayed into a tank in which the air is maintained at about 100° C. Means are provided for regulating the supply of air to, and the escape of gases from the tank. (B) A tank is provided with a steam injector, an air inlet and

outlet, an atomiser, and with means for heating the water before it is admitted to the atomiser. The atomised water collects in a discharge channel, from which it can be diverted should the temperature fall below a definite limit.—W. P. S.

Fumigating composition [for sterilising casks, etc.].—F. L. E. M. Signoret, Marseilles, France. Eng. Pat. 2150, Jan. 27, 1914. Under Int. Conv., Feb. 26, 1913.

SULPHUR is triturated to particles of less than 3 mm. diameter, immersed in 25—30% of its volume of commercial sodium (or potassium) silicate, dried, and compressed into blocks. The product may be burnt without risk of fused drops of sulphur becoming detached, and leaves a pumice-like residue.—F. SODN.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

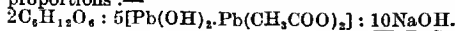
Camphor production in Formosa. Chem. Trade J., Jan. 9, 1915.

THE export of camphor from Formosa in 1913 declined from 8,649,319 lb., worth £553,550, in 1912, to 7,860,854 lb., worth £495,720. The total production of camphor during 1913 was 5,999,538 lb., to which must be added 3,573,802 lb. of camphor re-manufactured from 7,405,438 lb. of camphor oil, making the total output for the year 9,573,340 lb. Considerable stocks were in hand at the end of 1913. The future of the camphor industry continues to excite some apprehension owing to possible exhaustion of the existing camphor forests, and the tendency to diminution has been officially admitted. It is, nevertheless, claimed that present resources are sufficient to maintain an annual supply of about 6,500,000 lb. for eighteen years, and that by then the afforestation scheme will be far enough advanced for that quantity still to be produced. In 1913 about 3,000 acres were planted with 3,813,000 trees at a cost of £3,500, and as the scheme is to be continued for twelve years, large additions will be ultimately made to the existing reserves. Every effort is being made to render the method of production more efficient. In addition to distilling from the leaves of the camphor tree, efforts are being made to utilise profitably the dwarf camphor tree, which ordinarily produces very little camphor. Again, the 7,000 stills used throughout the country have been or will be rebuilt to give more efficient results. The export of camphor oil increased both in quantity and value, being 4,842,549 lb., worth £172,620, against 4,475,006 lb., worth £159,401, in 1912. The whole export went to Japan. The total production was 7,545,019 lb., but as mentioned above, a large quantity of camphor oil was re-manufactured. The re-manufacture of camphor oil leaves as by-products, brown oil, white oil, linalool, etc., which were exported to the value of £16,800. The estimated production of camphor during 1914 is about 6,500,000 lb., and of camphor oil 6,400,000 lb.

Allantoin in urine; Determination of.—in the presence of dextrose. R. H. A. Plimmer and R. F. Skelton. Biochem. J., 1914, 8, 641—648.

UREA and allantoin may be determined together by Folin's magnesium chloride method (which depends on the fact that the nitrogen of these bases is quantitatively converted into ammonia when they are heated with fused magnesium chloride), and the urea alone by means of urease, the difference in the two results giving the quantity of allantoin. The presence of

dextrose in the urine, however, interferes with the determination of the urea by Folin's method, from 9 to 30% of the nitrogen being lost, but the sugar may be removed by precipitation with basic lead acetate and sodium hydroxide in the proportions:—



—W. F. S.

Alkaloids of quebracho bark. I. Constitution of aspidospermine. A. J. Ewins. Chem. Soc. Trans., 1914, 105, 2738—2748.

THE bark of *Aspidosperma Quebracho* ("quebracho blanco") yielded 0.06 to 0.2% of the alkaloid aspidospermine, $C_{31}H_{43}O_2N_2$, crystallising in needles from alcohol, m. pt. 208° C., $[\alpha]_D = -99^\circ$ in alcohol and -93° in chloroform. It is only feebly basic and gives no crystalline salts. When boiled with hydriodic acid one methoxyl and one acetyl group are hydrolysed, giving a new base, *aspidosine*, $C_{29}H_{41}ON_2$, crystallising from alcohol or xylene in rectangular prisms or plates, m. pt. 244°—245° C., $[\alpha]_D$ about -16° ; this gives a hydriodide, m. pt. above 280° C., crystallising from hot water in octahedra and cubes. Aspidospermine on boiling with dilute hydrochloric acid is converted into *deacetylaspidospermine*, $C_{29}H_{41}ON_2$, m. pt. 110°—111° C., $[\alpha]_D +2.8^\circ$, which on acetylation is reconverted into aspidospermine and on benzylation gives *benzoyldeacetylaspidospermine*, m. pt. 180°—187° C. Deacetylaspidospermine warmed for a few moments with methyl iodide is converted into a substance, $C_{29}H_{41}ON_2 \cdot 2CH_3I$, crystallising from methyl alcohol in octahedra, m. pt. 176°—177° C., whilst with acetic acid and sodium nitrite it gives a substance, $C_{29}H_{41}O_2N_2$, probably *nitronitroso-deacetylaspidospermine*, which forms pale yellow prisms, m. pt. 155°—156° C. with decomposition. Aspidospermine oxidised with chromic acid gives a new base of probable formula, $C_{31}H_{43}O_2N_2$, m. pt. 192°—193° C., having a crystalline hydrochloride, m. pt. 286°—287° C. The existence of the various bases described by Hesse (this J., 1882, 200), with the exception of aspidospermine and quebrachine (yohimhine), could not be confirmed.—T. C.

Oxymorphine [pseudomorphine] in presence of morphine; Detection of— L. Grimbart and A. Leclère. J. Pharm. Chim., 1914, 10, 425—428.

THE hydrochlorides of the bases are dissolved in 100—1000 parts of water, and the solution neutralised and treated successively with equal volumes of a 1% solution of potassium ferricyanide and a 10% solution of sodium acetate. When the amount of pseudomorphine present does not exceed 1 in 20,000 there is no precipitate. The precipitated pseudomorphine is collected and washed by centrifuging, dissolved in 1 c.c. of dilute hydrochloric acid, and precipitated by a slight excess of potassium bicarbonate. It is again collected and washed by centrifuging, and redissolved in 1 c.c. of weak hydrochloric acid. Small portions are tested for pseudomorphine by the above reagents, or by a saturated solution of sodium sulphate. Treatment with sulphuric acid containing 1 drop of formaldehyde in 5 c.c. produces a Venetian red coloration, unless a trace of ferricyanide is present, when a green coloration appears. The ferricyanide reaction for precipitating pseudomorphine is not interfered with by morphine, codeine, thebaine, apomorphine, or other commonly occurring alkaloids.—F. SHON.

Digitalis. R. H. Hatcher. Druggists' Circular, 1914, 607. Amer. J. Pharm., 1914, 86, 567—568.

DIGITALIS of the first year's growth is probably as active as that of the second, and the cultivated is

as active as the wild-grown. The most active digitalis is not necessarily the best, the best being that which possesses maximum therapeutic action with a minimum of side actions, such as the nauseant and emetic. Digitalis will keep indefinitely when properly dried and stored. Pharmaceutical preparations of digitalis containing at least 60% of alcohol will keep indefinitely when securely corked and away from sunlight. At least two active principles, digitoxin and digitalin, and possibly a third, digitalcin, are obtainable from digitalis leaf, but it is not certain whether these exist as such in the leaf. No digitalis principle or preparation has the advantage of digitalis without its undesired effects. The tincture, as well as the infusion when properly made, represents all the activities of the leaf, and fat-free tincture has no advantages. The determination of the digitoxin content affords no index of the therapeutic or pharmacological activity, but the therapeutic activity may vary in the same direction as the digitoxin.—T. C.

Papain: Standardisation of commercial— F. W. Heyl, C. R. Caryl, and J. F. Staley. Amer. J. Pharm., 1914, 86, 542—550.

PAPAIN is supposed to have a higher digestive activity than the pawpaw juice (the dried albuminous exudation of the fruit of *Carica Papaya L.*) from which it is prepared, but no commercial product was found to have this increased activity. To determine the proteolytic activity, 1 c.c. of a 1% solution of papain or of pawpaw juice in 1% salt solution, which has been made up exactly 30 mins., is added, together with 9 c.c. of 1% salt solution, to 15 c.c. of egg-white solution in 1% salt solution, containing 0.4 gm. of coagulable protein, and the mixture is digested exactly 15 mins. at 80° C.; 1 c.c. of N/2 acetic acid is then added and the whole heated at 100° C. for 10 mins. The undigested protein is filtered off, washed free from chlorides and then with alcohol and with ether, and after drying at 100°—105° C. the weight is compared with that from a blank experiment under identical conditions. A genuine pawpaw juice should digest at least 40% of the egg-white protein under these conditions. *Test for pepsin:* 2 c.c. of 1% salt solution, 3 c.c. of N/2 HCl, and 5 c.c. of 1% papain are added to 15 c.c. of egg-white solution, 0.5 c.c. of toluene is added to prevent putrefaction, and the mixture is digested at 40° C. for 15 hours; 25 c.c. of 10% trichloroacetic acid is then added, the solution boiled for 10 mins., and the coagulum filtered off, washed, dried at 100°—105° C., weighed, and compared with the amount obtained from a blank experiment. Seven samples of dried pawpaw latex digested 0 to 2.9% under these conditions. Pawpaw juice should give a strong tryptophane reaction with bromine water after digesting with Witte's peptone, hydrocyanic acid, and hydrochloric acid for 17 hours at 36°—40° C., or 15 mins. at 80° C. Starch, sugars, and dextrin were found as adulterants in commercial samples of papain.—T. C.

Geranium and thyme oils; Constants of British East African— J. C. Umney. Perfumery and Essent. Oil Rec., 1914, 5, 423.

A SAMPLE of geranium oil distilled in British East Africa, probably from *Pelargonium radula* var. *quercifolium*, had the following constants: sp. gr. 0.890; optical rotation, -10° ; refr. index at 25° C., 1.4706; esters as geranyl acetate, 9.6%. The odour of the oil was reminiscent of labdanum. Three samples of thyme oil distilled in British East Africa from: (1) English thyme grown from seeds, (2) English thyme grown from young plants, (3) French thyme grown from seeds, had the following constants:—

	Yield.	Sp. gr.	Phenols.	Refr. index.	Phenols.
No. 1	0.50%	0.901	32%	1.4900	Solidify
No. 2	0.70%	0.905	32%	1.4768	Liquid.
No. 3	0.38%	0.903	40%	1.4908	Partly crystallise.

The phenols in the oil from plants grown from English seed consisted chiefly of thymol whilst the phenols in the oil from English plants were apparently chiefly carvacrol. The climate of British East Africa is entirely favourable to the growth of *Thymus vulgaris* and probably would also be well suited to *Origanum hirtum* and other plants of the same species.—T. C.

Bay leaf oil industry of the West Indies. Report of Botanic and Experiment Station, Montserrat. Perf. and Essent. Oil Rec., 1914, 5, 425—427.

THE bay leaf oil industry of the West Indies is gradually undergoing systematic improvement. An experimental plot of one acre was planted in Montserrat in 1908, and monthly reappings of the leaves commenced in January 1911, the yield of leaves and oil and the constants of the oil for each reaping being recorded to determine the factors operating towards improved yield and distillate. The monthly results obtained in 1913 are tabulated. It is suggested that bay leaf oil should be sold under certificate as the product of *Pimenta* or *Myrcia acris* and have a phenol content of 55—65%.—T. C.

Aspirin [acetylsalicylic acid]; Decomposition of — by water. D. E. Tsakalotos and S. Horsch. Bull. Soc. Chim., 1914, 15, 743—747.

IN aqueous solutions, acetylsalicylic acid decomposes slowly into acetic and salicylic acids. The decomposition of a solution of 1 grm. in 500 c.c. of water, as measured by the increase of acidity, was nearly complete in about 100 days, and was accelerated by mineral acids. Acetic and citric acids accelerated the decomposition at first, but afterwards had a slight retarding influence.

—F. SHDN.

Denatured alcohol for rectified alcohol; Rapid tests to detect the substitution of —. F. Richard. J. Pharm. Chim., 1914, 10, 429—437.

THE tests depend on the fact that acetone, always present in denatured alcohol, gives an immediate precipitate of iodoform when treated with iodine and an alkali. 1 c.c. of an aqueous or alcoholic liquid containing 1 part of acetone in 10,000 gives at once a distinct turbidity when treated with 1 c.c. of tincture of iodine prepared with pure alcohol or 2.5 c.c. of the official solution of iodine in potassium iodide and 20 c.c. of a 5% solution of potassium hydroxide. Iodine tincture is tested for the presence of denatured alcohol by mixing 1 c.c. with 20 c.c. of 5% of potassium hydroxide solution. The tincture may be shaken with copper turnings to remove the free iodine and neutralised, if acid, by treatment with copper oxide. When 5 c.c. is treated with a drop of a 0.1% solution of potassium permanganate the latter is immediately reduced if denatured alcohol be present. Preparations such as camphor tincture may be mixed with an equal volume of water and shaken out with twice the volume of pure ether, and the aqueous portion tested with iodine or permanganate.—F. SHDN.

Modification of the Kjeldahl method for determining nitrogen in organic substances. Wunder and Lascar. See XXIII.

XXII.—EXPLOSIVES; MATCHES.

Explosives; Production of — in the United States in 1913. A. H. Fay. Tech. Paper No. 85, U.S. Bureau of Mines, Washington, 1914.

THE total production of explosives in the United States in 1913 was 463,514,881 lb., a decrease of 25,878,250 lb. on the production in 1912 (see this J., 1914, 768). The production of black powder amounted to 194,146,747 lb., permissible explosives 27,685,770 lb., and other high explosives 241,682,364 lb. In coal mines of the United States, 209,352,938 lb. of explosive was used in 1913 to produce 570,048,125 tons of coal; this is an increased production from 2'36 to 2'72 tons of coal per lb. of explosive over 1912. The use of "permissible" explosives in coal mines continues to increase.

PATENTS.

Safety explosives. A. C. Percy, and Curtis's and Harvey, Ltd., London. Eng. Pats. 7647 and 17,656, March 26 and July 25, 1914.

A COOLING agent consisting of potassium nitrate, borax, and sodium or potassium chloride, is incorporated with a nitroglycerin-collodion cotton explosive.—O. E. M.

Nitrating cotton in vacuo; Process and apparatus for —. L. Dumons. First Addition, dated Feb. 14, 1914, to Fr. Pat. 445,833, July 6, 1912 (this J., 1912, 1203).

THE bottom of the nitrating vessel is connected with a three-way cock by means of which it can be connected with one or other of two receivers. By means of a four-way cock, which is operated in unison with the three-way cock, each of these receivers can be connected alternately with a suction device and with a supply of compressed air. The nitrating acid flows from a high-level reservoir into the nitrating vessel and thence into each of the low-level receivers in turn, whence it is raised by the compressed air to the high-level reservoir.—A. S.

Explosive charges; Process and apparatus for the preparation of — from fusible explosives by centrifuging. Deutsche Sprengstoff-Act.-Ges. Fr. Pat. 469,247, March 4, 1914. Under Int. Conv., March 29, 1913.

THE moulds containing the fused explosive are suspended from stirrups attached to the periphery of a horizontal disc, which is rapidly rotated. A solid charge of high density, free from blow-holes, is obtained.—A. S.

Explosives with liquid oxygen; Absorbent material for use in forming —. Soc. l'Air Liquide, Paris. Eng. Pat. 29,773, Dec. 24, 1913. Under Int. Conv., Dec. 28, 1912.

SEE Fr. Pat. 463,876 of 1912; this J., 1914, 376.

XXIII.—ANALYTICAL PROCESSES.

Iron; A sensitive reaction, and colorimetric method for the determination of —. L. Tschugaeff and B. Orelkin. Z. anorg. Chem., 1914, 89, 401—404.

FERROUS salts give with 1.2-dioximes an intense red coloration, and the reaction is so sensitive that, using dimethylglyoxime for example, less than 0.00000005 grm. Fe can be detected in a solution containing 0.00000006 grm. Fe per c.c. Since ferric iron does not give the reaction, the

addition of a reducing agent (*e.g.* hydrazine sulphate) is always necessary. For the colorimetric determination of minute quantities of iron, 50 to 70 c.c. of the solution is mixed with 1 grm. of hydrazine sulphate and 5 c.c. of a saturated alcoholic solution of dimethylglyoxime, heated to boiling, and, after adding 10 c.c. of 25% ammonia, again heated for half a minute. The liquid is then diluted to 100 c.c. and compared with a standard tint freshly prepared from a solution of known iron content. The results are accurate to within 1–2% and are not influenced by the presence of alkali, alkaline earth, or magnesium salts. Zinc and aluminium, on the other hand, vitiate the accuracy of the determination.

—G. F. M.

Zinc; Cyanometric determination of—W. D. Treadwell. *Chem.-Zeit.*, 1914, 38, 1230–1232. (See also this J., 1910, 300, 375.)

FOR single volumetric determinations of zinc the use of standard potassium cyanide solution is preferable to titration with sodium sulphide or potassium ferrocyanide. The method gave satisfactory results in very dilute solutions: *e.g.* amounts of zinc varying from 0.25 to 0.01 grm. in 100 c.c. gave a mean error of 0.3 mgrm. Quantities of 6 mgrms. were estimated with fair accuracy by working at 5° C. Special operations are necessary in determining zinc in ores. A weighed amount (*e.g.* 0.5 grm. for an ore containing 30% Zn) of the powdered ore is evaporated almost to dryness in a covered porcelain dish with concentrated hydrochloric acid (7 c.c.), a little concentrated nitric acid being added if necessary. After partial cooling the residue is heated with a slight excess of sulphuric acid until copious white fumes are evolved, washed into a conical flask with water (25 to 40 c.c.), and digested with sulphuric acid (10% free acid) and aluminium turnings (5 grms.) until complete precipitation of the copper and reduction of the iron are attained. The solution is filtered rapidly, neutralised with sodium hydroxide, using methyl-orange indicator, and, after the addition of sulphuric acid (3 to 5 c.c. N/1 acid per 100 c.c.), treated with hydrogen sulphide for 15 mins. The corked flask is kept in a warm place for 30 mins. and the cooled contents are then filtered, and the filter thoroughly washed with a 2% ammonium sulphate solution containing a little hydrogen sulphide. Dilute hydrochloric acid (5 to 7 c.c. concentrated acid to 10 c.c. water) is next passed repeatedly through the filter, which is finally washed 5 or 6 times with hot, very dilute hydrochloric acid. Hydrogen sulphide is boiled off completely from the filtrate and washings, which are then washed into a small flask provided with a ground-glass stopper. First strong, then N/2, potassium hydroxide is added drop by drop till the solution is neutral to methyl-orange. Ammonium chloride (1 grm.) is added and the solution titrated with N/2 potassium cyanide between 15° and 20° C. At the point marked by the clearing of the liquid $4\text{CN} \equiv \text{I Zn}$. Cadmium is not completely precipitated by aluminium: in this case, after treating with aluminium, hydrogen sulphide is passed into the hot solution until it becomes cold, the precipitate is filtered off after 30 mins., the greater part of the hydrogen sulphide boiled off, and the process continued as above. Electrolytic alkali, containing hypochlorites, is unsuitable for these processes. Acid solutions containing only zinc and iron are neutralised with dilute alkali until the resulting cloudiness disappears only with difficulty. To the boiling diluted solution (300 c.c.) is then added, drop by drop, a solution of potassium nitrite (1 grm.) and ammonium chloride (1 grm.). After settling, the precipitate is separated and washed well with hot water: provided that not more than 0.1 grm. iron

was originally present it is then free from zinc. The filtrate and washings are concentrated on the water-bath to 150 c.c., and the treatment with potassium nitrite and ammonium chloride is repeated. The ensuing filtrate, after concentrating to 40 c.c., is freed from nitrous acid by boiling with hydrochloric acid, washed into a flask, neutralised, and titrated with potassium cyanide.

—J. R.

Nitrogen in organic substances; New modification of the Kjeldahl method for the determination of—M. Wunder and O. Lascar. *Ann. Chim. Analyt.*, 1914, 19, 329–332.

FROM 0.1 to 0.6 grm. of the substance is weighed into a glass tube about 15 mm. high and 10 mm. in diameter, and introduced into a 300 c.c. vessel of Jena glass together with 3 grms. of oxalic acid, 2 grms. of sodium oxalate, and 0.5 grm. of freshly calcined vanadium pentoxide. A mixture of 5 c.c. of syrupy phosphoric acid and 25 c.c. of concentrated sulphuric acid is then added, cooling if necessary, and the mixture is heated gradually, with frequent shaking, until the organic matter is completely destroyed, when the liquid assumes a yellowish-green colour. If the organic substance contains nitrogen directly united to oxygen, two or three pieces (about 0.75 grm.) of iron wire should be added during the heating, and in all cases, after the liquid has cooled, it is diluted with 100 to 150 c.c. of water and heated gently with 0.5 to 0.75 grm. of iron wire for 30 mins. It is then transferred to a large flask, made alkaline with sodium hydroxide, and subjected to the ordinary Kjeldahl distillation process, the ammonia being absorbed in N/5 H₂SO₄. The method is applicable to the determination of nitrogen in all forms of combination, and results are given with such different substances as morphine, indole, nitroso-dimethylaniline, oximes, and picrates, which show excellent agreement with the theoretical values.

—G. F. M.

Phosphorus; Gravimetric determination of minute quantities of—H. S. Raper. *Biochem. J.*, 1914, 8, 649–655.

BREARLEY and Ibbotson's method for the determination of phosphorus in steel is modified so as to be applicable to organic substances of which the quantity available is but small; the method consists, essentially, in oxidising the phosphorus to phosphoric acid, precipitating this as ammonium phosphomolybdate, and determining the molybdenum in the precipitate as lead molybdate. The substance is oxidised in the usual way with about 10 c.c. of a mixture of nitric and sulphuric acids, the volume of the residual solution is measured, and the solution is rinsed into a flask; 15 c.c. of 50% ammonium nitrate solution is added, then 0.75 c.c. of ammonia (sp. gr. 0.88) for each c.c. of the residual acid solution, and the whole is diluted to 100 c.c., heated to 80° C., treated with 10 c.c. of 10% ammonium molybdate solution and shaken for about 2 minutes; if precipitation does not commence within this time, less than 1 mgrm. of P₂O₅ is present and 5 c.c. of potassium hydrogen phosphate solution (5 c.c. = 1 mgrm. P₂O₅) is added; the mixture is maintained at 80° C. for a further 20 minutes, the precipitate then collected on a small paper-pulp filter, washed twice with cold water, dissolved in 6 c.c. of 10% ammonia, and the phosphoric acid again precipitated by treating the solution with 11 c.c. of nitric acid, 8 c.c. of ammonium nitrate and 8 c.c. of ammonium molybdate solution, and heating to 80° C. for 20 minutes. The yellow precipitate is collected, dissolved in 6 c.c. of dilute ammonia, 11 c.c. of concentrated hydrochloric acid and 10 c.c. of 4% lead acetate solution added, the mixture

heated to boiling and poured into a boiling mixture of 50 c.c. of 20% ammonium chloride solution and 50 c.c. of 50% ammonium acetate solution. The precipitate of lead molybdate is collected, washed with hot water, dried, ignited, and weighed. The weight of the precipitate multiplied by 0.0150 gives the quantity of P_2O_5 . If 5 c.c. of phosphate solution were added, 1 mgrm. of P_2O_5 is deducted from the result. The method may be employed for the determination of quantities of P_2O_5 as small as 0.1 mgrm.—W. P. S.

Flame standards in photometry. Rosa and Crittenden. See IIB.

Determination of ammonia by the boric acid method. Winkler. See VII.

Detection of carbonic acid, especially in mixtures of carbonate and sulphite. Petersen. See VII.

Salts coloured by cathode rays. Goldstein. See VII.

Determination of nitrogen in steel. Barton. See X.

Analysis of platinum. Mylius and Mazzucchelli. See X.

Determination of copper and lead in Babbitt metal. Hagmaier. See X.

Influence of atmospheric conditions in the testing of sugars. Bates and Phelps. See XVII.

Determination of original gravity of beers by the distillation process. Thorpe and Brown. See XVIII.

Value of dried brewers' grains as a feeding material. Halnan. See XIXA.

Rapid determination of magnesium in water analysis in presence of calcium. Froboese. See XIXB.

Detection of oxymorphine [pseudomorphine] in presence of morphine. Grimbert and Leclère. See XX.

Standardisation of commercial papain. Heyl and others. See XX.

Rapid tests for detecting the substitution of denatured alcohol for rectified alcohol. Richard. See XX.

Determination of allantoin in urine in presence of dextrose. Pimmer and Skelton. See XX.

PATENT.

Gas-analysis apparatus; Automatic —. C. W. Heath, Cincinnati, Ohio. U.S. Pat. 1,121,244, Dec. 15, 1914. Date of appl., Feb. 21, 1913.

The gas is drawn into a measuring vessel by the outward movement of an inert liquid separated from the driving liquid by a flexible diaphragm. The gas is then displaced through an absorbing vessel to a second measuring vessel by the inward movement of the inert liquid, the result of the analysis is automatically recorded, and the gas residue discharged.—W. P. F.

XXIV.—MISCELLANEOUS ABSTRACTS.

Chemiluminescence. S. Moeller, Archiv Pharm. Chem., 21, 440. Pharm. J., 1915, 33.

The appearance of light has been noted in several chemical reactions, notably in that of Grignard, when an ether solution of an alkyl halide reacts

with magnesium dust. A red light is developed on mixing 35 c.c. of each of the following solutions:—A 1:2 potassium carbonate solution, a 1:10 pyrogallol solution, and a 35:100 formaldehyde solution; then adding 50 c.c. of 30:100 hydrogen peroxide solution. Also phenylmagnesium bromide, in ether solution, develops an intense green light on contact with moist air. The effect is not, however, due to the moisture, but to oxidation. The luminescence is stronger in an atmosphere of pure oxygen than in other gases. Ether which has stood for some months over calcium chloride reacts well; some, but not all, specimens of official ether do so also. Chemiluminescence is observed with most organic magnesium compounds, and its intensity is directly proportional to the molecular weight of the halogen derivative.

Reductase; Action of poisons on — and attempts to isolate this enzyme. D. F. Harris and H. J. M. Creighton. Biochem. J., 1914, 8, 585–590.

THE reductase present in pigeon's liver and muscle is soluble to some extent in 0.75% sodium chloride solution and in a mixture of this solution with glycerol, but not in pure glycerol; all attempts to isolate the active enzyme failed. The action of a number of substances (arsenious acid, potassium cyanide, mercuric chloride, gold chloride, osmic acid, manganous chloride, formaldehyde, etc.) on the activity of the enzyme is recorded. At higher concentrations some of the substances are relatively much more poisonous than at lower concentrations. Thus, formaldehyde has no toxic action in 0.01 molar solution but is the most active poison when the concentration is increased to 0.1 molar. The action of the poisons is discussed from a physiological point of view.—W. P. S.

Hydroxides of silicon, aluminium, and iron; Adsorptive power of —. VII. P. Rohland. Z. anorg. Chem., 1914, 89, 164–166.

THE determining factor in the adsorption of dye-stuffs by colloidal clay, and also by colloidal hydrated zirconium oxide (this J., 1912, 847; 1913, 792) is the colloidal character of the dyestuff and not its acid or basic nature (compare Chapman and Siebold, this J., 1912, 808), or the number of atoms in its molecule (compare Biltz, this J., 1911, 677). For example, Vesuvium, a basic dyestuff, is only sparingly adsorbed, and Aniline Red, Malachite Green, Fluorescein, and Aurin, though having less than 55 atoms in the molecule, are all adsorbed by kaolin. The failure of Carli (Z. physik. Chem., 1913, 85, 2) to observe appreciable adsorption of colloidal ferric hydroxide by kaolin was probably due to the use of kaolin of low plasticity. Highly plastic kaolin from Saxony adsorbs colloidal ferric hydroxide almost completely.—A. S.

Trade Report.

Competition with Germany and Austria-Hungary.

IN connection with the efforts of the Board of Trade to assist British manufacturers and merchants to secure trade formerly in the hands of Germany and Austria-Hungary, lists have been prepared showing articles which a number of inquirers desire to purchase or to sell. The seventh list is now ready, and may be obtained by United Kingdom manufacturers and traders, together with copies of the previous lists (see this J., 1914, 806, 946, 1037, 1077), on application to the Board of Trade, Commercial Intelligence Branch, 73, Basinghall Street, London, E.C.

German Bureau of Chemical Technology. Chem. Trade J., Jan. 9, 1915.

THE recently organised German Advisory Bureau for Technical Subjects and Chemical Technology (Deutsche Begutachtungsstelle für Technik und Chemische Technologie) intends to open a central bureau in Hamburg to give information on all subjects connected with German manufactures and all new products put on the market. This undertaking is said to be well supported financially, and should prove very useful to German trade. Catalogues of all German manufacturers will be collected and classified. Special attention will be given to pushing German interests abroad. In carrying out this object the Advisory Committee will conduct its operations in all civilised countries. The Institute will employ a number of technical engineers and chemists, who will not only be skilled in their particular branches, but have a thorough practical knowledge of foreign languages. Care will be taken to co-operate with the manufacturing and commercial interests concerned, and to maintain the Advisory Bureau as a neutral official institution, whose opinions will be given from a strictly impartial standpoint. The institute is independent, it is asserted, of any private commercial or trade interests whatsoever.

France. Prohibited exports. Board of Trade J., Jan. 7, 1915.

A FRENCH Presidential Decree, dated the 21st December, embodies a revised list of prohibited exports. In virtue of this Decree, the exportation and re-exportation of the undermentioned articles from France is prohibited:—Acetone; acetic acid and medicinal salts thereof; nitric acid; salicylic acid; sulphuric acid; special steel; anil, methyl and ethyl alcohols; anhydrous and hydrated alumina and salts of alumina; aluminium, ore and metal, pure or alloyed; antimony, ore and metal, pure or alloyed; antipyrine; aspirin; atropine; beetroots destined for the manufacture of sugar; bismuth and bismuth salts; rosin, colophony, oil of turpentine; bromine and bromides; caffeine; camphor; indiarubber, balata, gutta-percha, crude or melted down, including rubber waste and ebonite; calcium carbide; wood charcoal; carbons for electricity; chloral; chlorates and perchlorates; chloroform; chloride of lime; scrap and waste iron and steel; cocaine; collodion; wood creosote; copper, ore or metal, pure or alloyed, boiler-makers' wares and tubes of copper; hydrogen peroxide; cinchona bark; tin, ore or metal, pure or alloyed; sulphuric acid and acetic ethers; ferro-chrome, ferro-nickel, and all ferro-metallic alloys; insulated wire and cable for electricity; formol; oleaginous fruits and seeds; glycerin; mineral tar and chemical products derived therefrom; animal greases (fats) other than that from fish (tallow, lard, lanoline, margarine); mineral oils, crude, refined, essences and heavy oils (petrol, benzol, toluene, etc.); castor and pulghera oils; iodine, iodides, and iodoform; condensed milk, with or without the addition of sugar; yeasts; filings and waste of copper, tin, zinc, pure or alloyed; magnesium; mercury (ore and metal); chrome, manganese and tungsten ores; iron ore; nickel, ore or metal, pure or alloyed; nitrates and nitrites; opium and preparations with base of opium; platinum; photographic plates and papers; lead, ore and metal, pure or alloyed, lead pipes; potassium, potash and potash salts; gunpowder and similar explosives (gun-cotton, nitrated cotton, nitroglycerin, etc.); amidopyrine (pyramidon); quinine and salts thereof; sea salt, salina salt, and rock salt, crude or refined; thorium salts, cerium salts, and other salts of rare earths; caustic soda; sulphur and pyrites; sugar,

unrefined, refined, and candy; sulphonal; dyes derived from coal-tar (alizarin, aniline); theobromine; cake from oilseeds, and brewery dregs for feeding cattle; zinc, ore or metal, pure or alloyed.

Exemption from the above prohibitions, however, may be accorded, under conditions to be laid down by the Ministry of Finance. General permission has been granted for the export of iron ore to the United Kingdom.

German prohibition of exports. Chem. and Drug, Jan. 16, 1915.

THE Pharm. Zeit., in its issue of January 2, 1915, states that a new Decree of December 24, 1914, prohibits the exportation from Germany of the following medicinal and pharmaceutical products. At the same time all former Decrees are revoked:—Acetanilide; acetylsalicylic acid (aspirin); alpine; arecoline and arecoline hydrobromide; ethyl ether; ether (anæsthetic); atropine and its salts and other derivatives; bromine, bromides, hydrobromic acid, bromates, and organic bromo-compounds; cinchona-bark, quinine, quinine salts, and other quinine derivatives; chloral hydrate, methyl and ethyl chlorides in tubes and flasks; chloroform; coca-leaves, cocaine and its salts; colchicine; diethylbarbituric acid and its salts (e.g., medinal); digitalis-leaves and their preparations (e.g., digalen, etc.); duboisine and its salts and other compounds; eucalae; formaldehyde solution, paraformaldehyde; galls; gutta-percha-tissue; ipecacuanha (also when free of emetine); iodine (crude and re-sublimed), hydriodic acid, iodides, and organic iodo-compounds; carbolic acid; rubber; codeine and its salts; caffeine and its salts, derivatives, and preparations; cresol, cresol-soap solutions, lysol; mastic and mastic preparations, such as mastisol; morphine and its salts and compounds; anæsthetic mixtures (such as Schleich, etc.); novocaine and its compounds and preparations; opium and opium-preparations (such as powdered opium), opium tinctures, opium extract; pantopon; paraffin; Peru balsam; phenacetin; propional; dimethylaminophenyldimethyl-pyrazolone (pyramidon); phenyldimethylpyrazolone (antipyrin); phenyldimethylpyrazolone salicylate (salipyrin); mercury and mercurials and preparations, such as ointments, tablets of corrosive sublimate; castor oil; salicylic acid and its salts; salvarsan and neo-salvarsan; colchicum-seeds and preparations thereof; Schleich's solutions and Schleich's tablets for the preparation of the solutions; scopolamine (hyoscine) and its salts; suprarenine, adrenalin, paranephrine, epinephrine, epirenan, and their compounds and preparations; senega; simarubra-bark; theobromine and its salts, compounds and preparations; tropacocaine and its compounds and preparations; vaseline; veronal, veronal sodium; tartaric acid; bismuth and bismuth-compounds; wool-fat, lanoline; citric acid. A large number of articles for which the prohibition of exportation had been revoked are replaced on the list—e.g., salvarsan and neo-salvarsan.

Books Received.

COPPER SMELTING INDUSTRIES OF CANADA. A. W. G. Wilson. Report No. 209. Dept. of Mines, Canada. See X.

INDEX TO PATENTS, TECHNOLOGY, and BIBLIOGRAPHY OF CHINA WOOD OIL. G. H. Stevens and J. W. Armitage. See XII.

